ORDNANCE

LAND · SEA · AIR

Heavy Tank T43E1

JANUARY-FEBRUARY 1955

(In two sections: Section I)

Completely new Bullard Cut Master V.T.L. Model 75 uses TIMKEN® bearings to insure extra load capacity, top precision

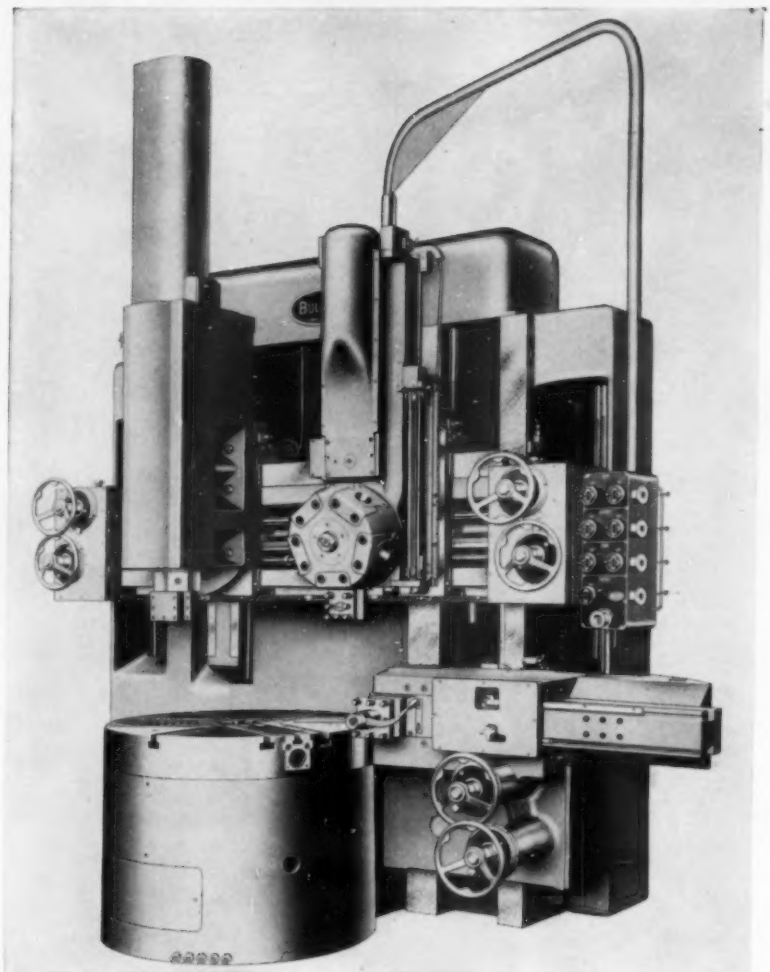
TO reduce power losses and provide highest efficiency at point of cutting, The Bullard Company engineers chose Timken® tapered roller bearings for the Bullard Cut Master Model 75, a completely new design of vertical turret lathes. Timken bearings are used in the table, headstock, feed and traverse mechanism, side, ram and turret head drives and other applications throughout the machine. They have been selected to meet the service requirements at each vital point with maximum efficiency. From 160 up to 196 Timken bearings are used according to the number and types of heads selected.

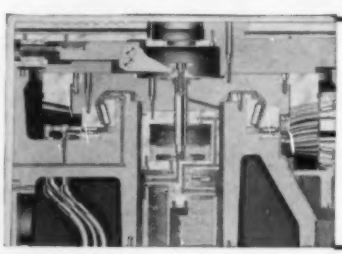
Timken bearings have extra load-carrying capacity that results from line contact between rollers and races. Tapered construction permits preloading, so deflection is kept to a minimum, and constant accuracy is maintained. Radial and thrust loads can be carried in any combination. Timken bearings are geometrically designed to roll true and precision manufactured to live up to their design. They hold shafts in rigid alignment, insure accurate gear mesh.

We take every step possible to make Timken bearings the best. We even make our own steel so we can control quality from beginning to end. We're the only U.S. bearing manufacturer that takes this extra step.

Make sure the machines you build or buy have bearings with the trademark "Timken". They're number one for value. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ont. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best





BULLARD design of table bearing construction uses Timken tapered roller bearings for long life, trouble-free performance.

TIMKEN
TRADE-MARK REG. U. S. PAT. OFF.
TAPERED ROLLER BEARINGS

NOT JUST A BALL NOT JUST A ROLLER THE TIMKEN TAPERED ROLLER

BEARING TAKES RADIAL AND THRUST LOADS OR ANY COMBINATION

ORDNANCE

LAND · SEA · AIR

The Magazine of Scientific and Industrial Preparedness

VOL. XXXIX JANUARY-FEBRUARY 1955 NO. 208

The Cover.—*Weighing about 60 tons and armed with a high-velocity 120-mm. gun and caliber .30 and .50 machine guns, the T43E1 tank combines the characteristics of mobility, firepower, and protection to a high degree.*

Editor: Leo A. Codd. *Managing Editor:* R. E. Lewis. *Editorial Staff:* M. L. Van Horn, R. K. Smith.

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FOR TV . . . IT DODGES TROUBLE YOU CAN'T STOP

Radio Relay station on route between Chicago, Ill., and Des Moines, Iowa. Every fifth or sixth relaying tower is a control station, where high-speed switching equipment enables a TV picture to skip out of a troubled channel and into a stand-by protection channel faster than the eye can wink.

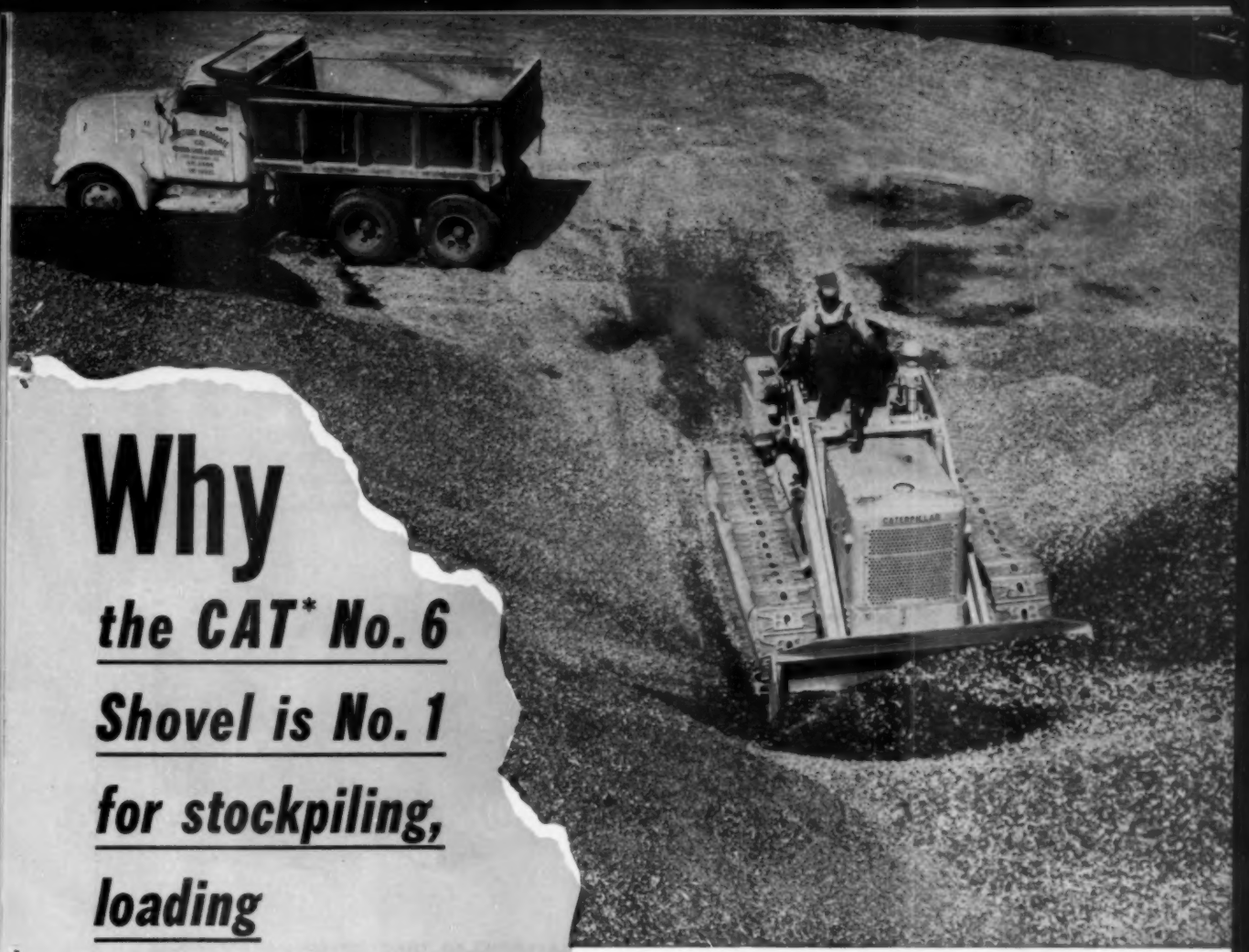
There's no way to stop atmospheric changes that threaten television with "fade." But, for TV that travels over Bell's Radio Relay System, Bell Laboratories engineers have devised a way to sidestep Nature's interference.

When a fade threatens – usually before the viewer is aware – an electronic watchman sends a warning signal back by wire to a control station perhaps 200 miles away. An automatic switching mechanism promptly transfers the picture to a clear channel. The entire operation takes 1/500 of a second. When the fade ends, the picture is switched back to the original channel.

This is an important addition to the automatic alarm and maintenance system that guards Bell's Long Distance network for television and telephone calls. It marks a new advance in Bell Laboratories' microwave art, developed to make your Long Distance telephone service, and your TV pictures, better each year.

BELL TELEPHONE LABORATORIES

Improving telephone service for America provides careers for creative men in scientific and technical fields.



Why *the CAT* No. 6 Shovel is No. 1 for stockpiling, loading*

Wherever big stockpiles of material have to be handled, the Caterpillar No. 6 Shovel is proving itself as the most efficient unit in the field.

Industrial Aggregate Co., of Minneapolis, Minn., is a major supplier of washed sand, buckshot gravel and standard aggregates for the surrounding area. At its large stockpile in northeast Minneapolis a Cat No. 6 Shovel loads some 500 tons of material a day, in addition to bulldozing around the yard. Average time for loading a 7-yard truck is only 76 seconds.

A. J. Egan, general manager, says: "This shovel is giving us good service. We like the hydraulic controls that make truck-loading easy. It's a good machine —that's what we expected of Caterpillar-built products."

The bucket of the Caterpillar No. 6 Shovel is 8 feet wide, with a capacity of 2 cubic yards. Its replaceable cutting edge is specially hardened for long wear. Rugged box-section lift arms are cross-braced for extra strength, and provide high lift for easy loading.

This big yellow machine is built to do more work, at lower cost, and to stay on the job longer than any competitive unit. Factual records prove its economy and high production. Your Caterpillar Dealer will gladly give you a demonstration—on the job. You can depend on him for prompt, reliable service. Call him today.

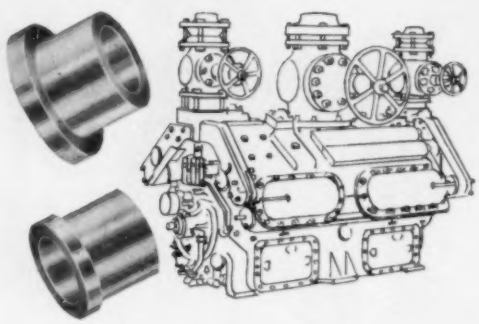
Caterpillar Tractor Co., Peoria, Ill., U.S.A.

CATERPILLAR*

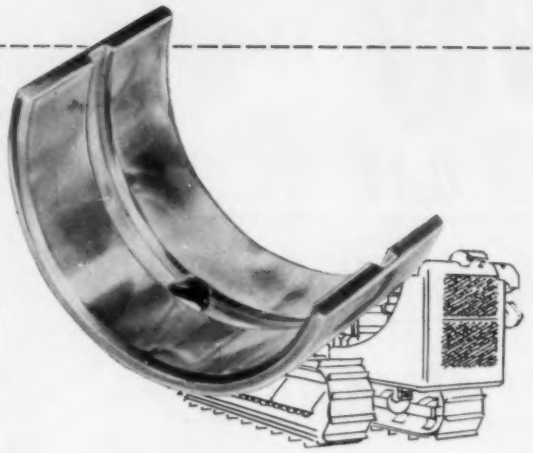
*Both Cat and Caterpillar are registered trademarks—®

NAME THE DATE... YOUR DEALER WILL DEMONSTRATE

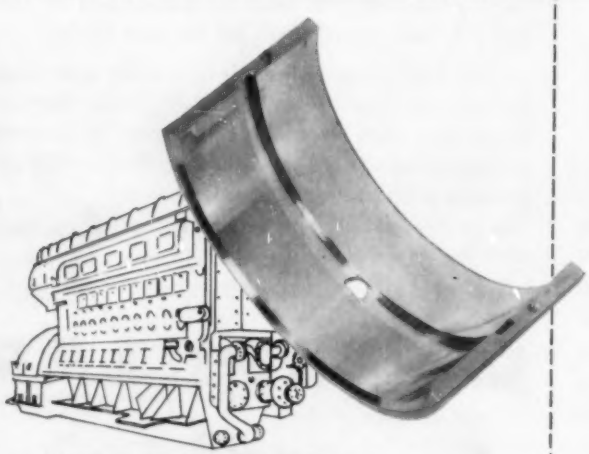
Suppose, like these designers, you just want to eliminate trouble



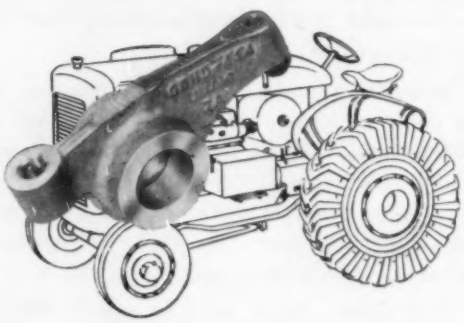
YORK CORP.—use sleeve-type load and thrust bearings of cast aluminum alloy that last 20,000 hours and more. They solve service problems, carry heavier loads, are easier to machine, prevent shaft damage.



CATERPILLAR TRACTOR CO.—use solid aluminum for main connecting rod and thrust bearings in their tractor. In addition to longer life, the solid aluminum bearings showed a much lower percentage of failures than previously used materials.



FAIRBANKS, MORSE & CO.—switched from steel-backed or bronze-backed babbitt to solid aluminum for crankshaft bearings. They report an increase of at least 10 times in bearing life, with added advantages of corrosion resistance, freedom from shaft damage and reduced rotating weight.



SCHRAMM, INC.—use an entire rocker arm cast of Alcoa Aluminum bearing alloy. They avoid costly forging dies for steel arms and costly machining necessary for conventional bushing inserts.

● There were three points in manufacturing history when designers could have demanded 24-karat gold for bearings. It happened once during World War I, when the Liberty Engine was born. Again when the Luftwaffe became the scourge of World War II skies. It happened when Rolls Royce built their Bentley automobile for millionaires.

What did these designers use when they could have demanded anything? ALUMINUM. And because of their early conviction that aluminum was the finest bearing material obtainable, scores of companies today are switching to solid aluminum bearings.

What do they get from aluminum that neither babbitt nor bronze nor any multimetalic combination offers? *No bond problems.* One-piece aluminum bearings *take tremendous loads* without failure.

Where additive oils are used, these engineers specify aluminum, knowing its *natural corrosion resistance* protects them. Where hot spots are likely, they know aluminum's *swift thermal conductivity* lessens seizures. Where dirt is a problem, they know aluminum *embeds particles* almost as well as babbitt —far better than bronze.

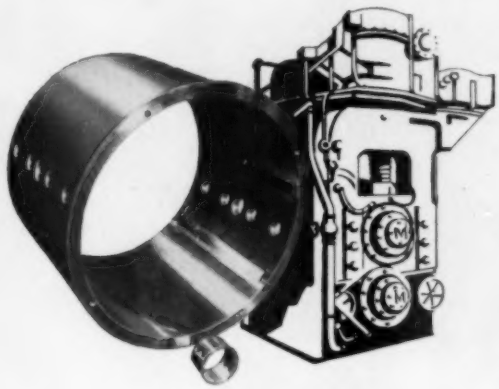
Who will be next to quadruple the life of his bearings? It could be the man who fills out the coupon below.

ALUMINUM COMPANY OF AMERICA
850-A Alcoa Building, Pittsburgh 19, Pa.

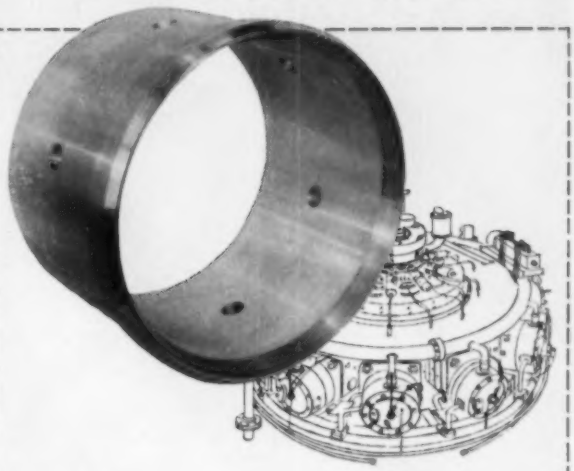
Gentlemen: I would like to discuss aluminum bearings with an Alcoa sales engineer.

Name _____ Title _____
Company _____
Street and Number _____
City _____ Zone _____ State _____

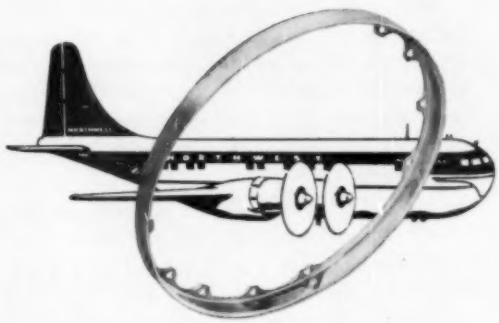
ALCOA ALUMINUM
ALUMINUM COMPANY OF AMERICA



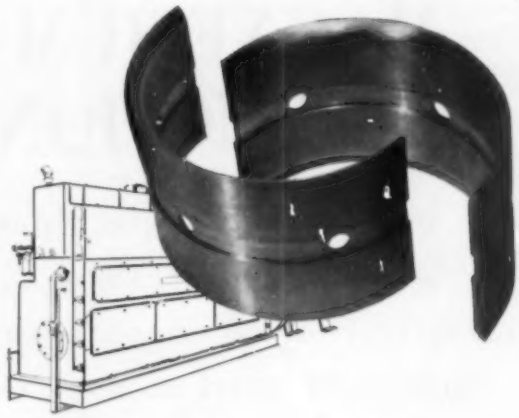
MORGAN CONSTR. CO.—use solid aluminum for their Morgoil Roll Neck Bearings in rolling mills. They report longer life than previously used steel-backed cadmium bearings, better corrosion resistance, better performance at high and low speeds on both hot and cold mills.



NORDBERG MFG. CO.—use full, round, solid bushings of Alcoa® Aluminum. They prove far superior to babbitt—give longer life—lessen maintenance interruption. Over 20,000 operating hours without failure.

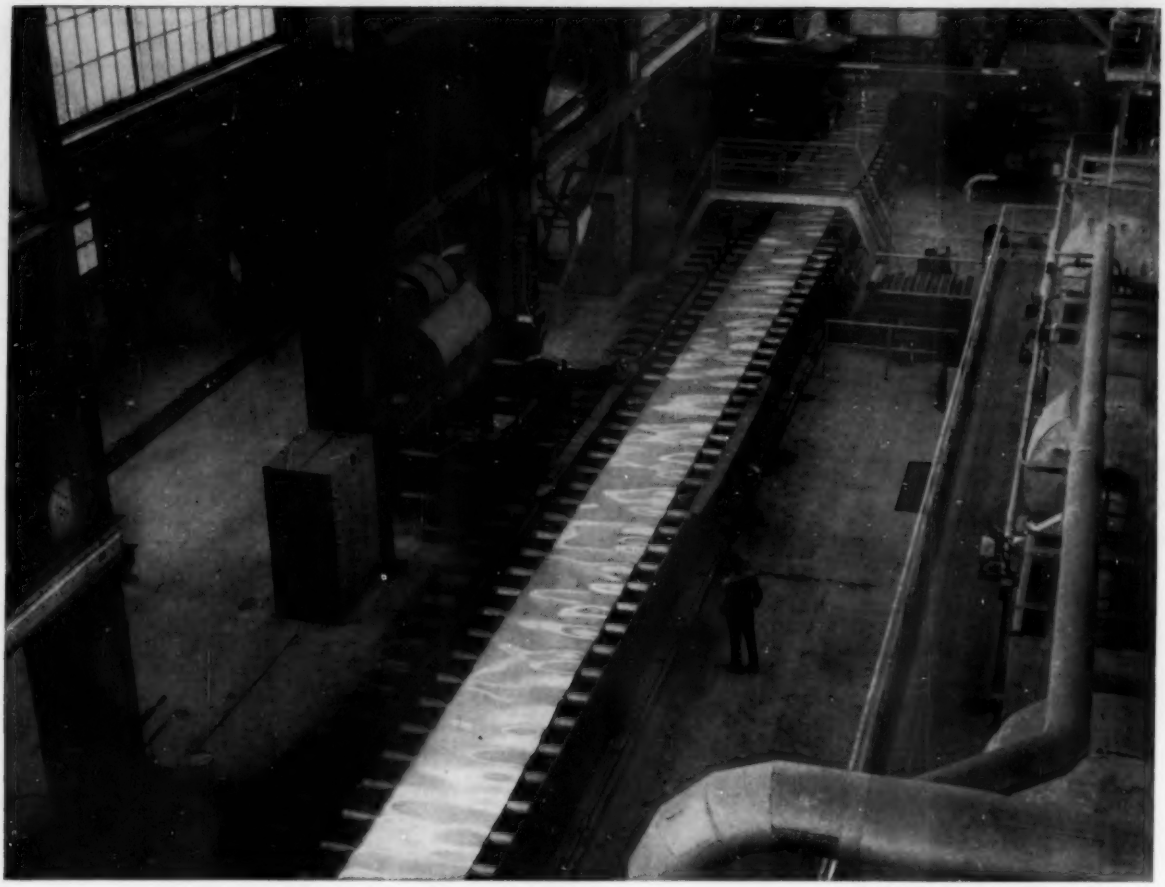


PRATT & WHITNEY—needed a bearing material to withstand the sliding action of steel on their cam bearing. They used a solid aluminum bearing with excellent scuff resistance—saved 65 per cent weight—got better bearing performance.



INGERSOLL-RAND CO.—specified full floating bearings of solid Alcoa Aluminum for main connecting rod and thrust bearings. Results: longer life and lower cost than steel-backed babbitt, no spoiled crankshafts.

DOW



World's first magnesium 84" coil mill.

NEW, EXPANDED MAGNESIUM PRODUCTION

... based on the newest volume production techniques and Dow's many years of experience with the lightweight metal of many uses

Designers and engineers, long familiar with the high strength/weight ratio, the workability, the variety of alloys and general usefulness of magnesium, are now taking a *new* look at this ultralight metal. Big reason for this interest is the tremendous expansion of Dow facilities, now supplying larger quantities of magnesium plate, sheet and extrusions—in shapes, sizes and forms never before available.

As a result of Dow research, powerful electrolytic cells continue to extract magnesium from an unlimited source of raw material—sea water. This, plus the expanded production facilities, insures an adequate future supply of magnesium, even for the many new applications being developed. THE DOW CHEMICAL COMPANY, Midland, Michigan.

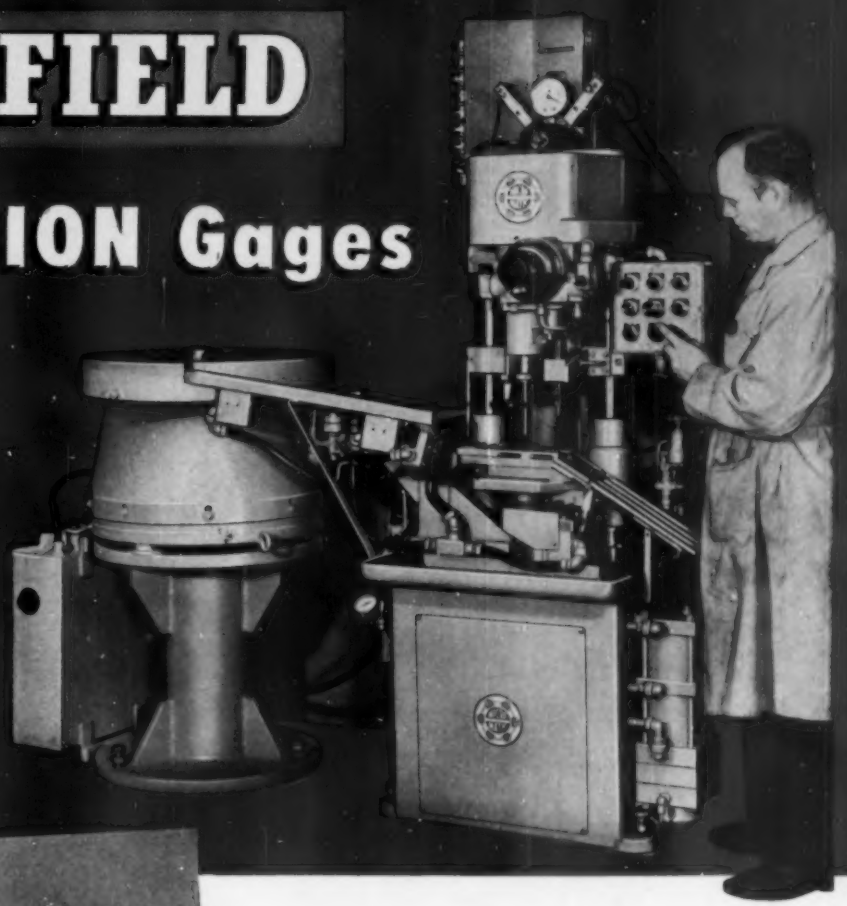
you can depend on DOW MAGNESIUM DOW

SHEFFIELD

AUTOMATION Gages

Assure Fast Accurate Machining

Sheffield Automation Gages are packaged units, ready-to-use and economically priced, for the control of grinding, boring, drilling, honing, milling and turning operations.



Mounted on machine tools, they measure work part dimensions and space relationships and instantly translate this information into electrical impulses which in turn:

- **Energize signal lights**
- **Actuate solenoid ejection or classification mechanisms**
- **Start and stop the machine tool**
- **Provide feed-back control**
- **Control cutting tool or grinding wheel positioning and compensation, also time cycle.**

A Typical Application

Here the bore of transmission pinions is being honed and gaged automatically.

If the actual bore size, after honing, is within .0001" of either tolerance limit, white warning lights flash on.

If either tolerance is exceeded, a red or green signal flashes and the faulty part is automatically ejected.

When a predetermined number of rejects pass through in succession the machine is automatically stopped.

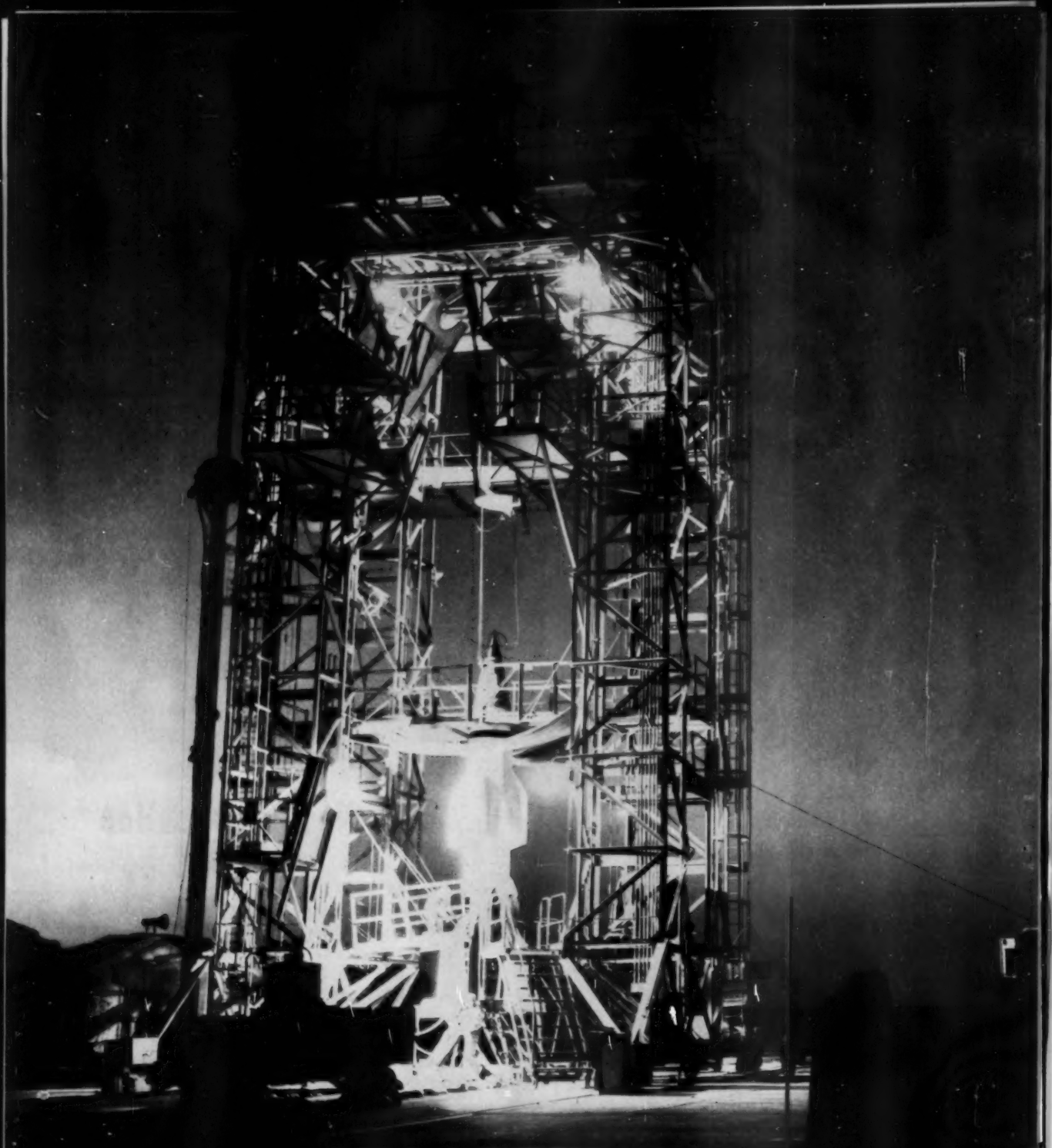
The actual size of each bore, as it is gaged can be read on a conveniently located air gage dial as built into the machine tool pneumatic circuit.

The Sheffield Corporation, Dayton 1, Ohio, U.S.A.

MASTER CRAFTSMAN SHEFFIELD HEADQUARTERS

SHEFFIELD

Sheffield AUTOMATION ENGINEERS will gladly consult with you about automatizing your production.



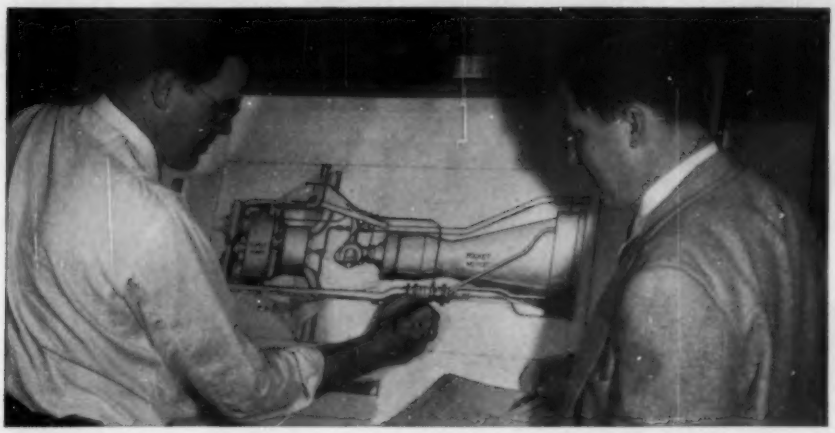
G.E.'s decade of guided missile progress is symbolized by one of the missiles designed and developed for the Department of the Army by General Electric being readied in the early morning for flight test at the White Sands Proving Ground.

GENERAL ELECTRIC

How G.E.'s decade of guided missile progress can aid your missile project

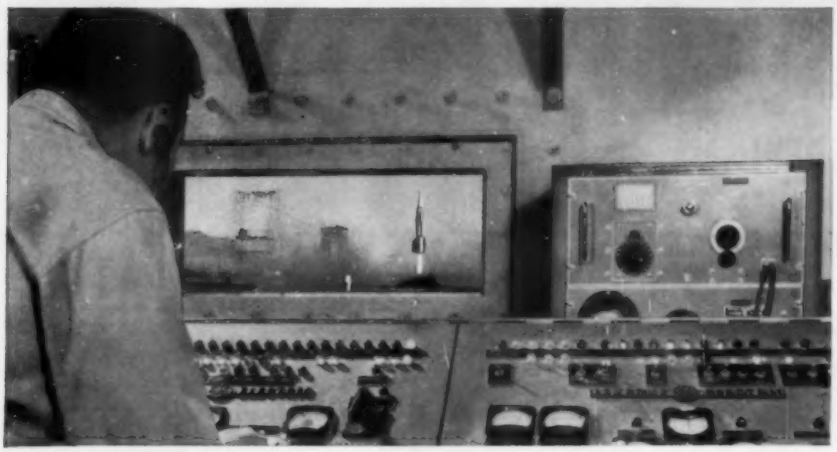
Starting on November 15, 1944, General Electric scientists, following on the heels of our advancing armies, began a study of German rocket development. Since that date, G-E engineers and scientists, working closely with the Army Ordnance Corps, have obtained much guided missile experience.

This experience is available to aid your missile project. Having participated in all phases of guided missile development and production, General Electric is well equipped to handle any missile problem. G.E.'s range of experience includes—Propulsion—Guidance—Systems Test—Air Frame.

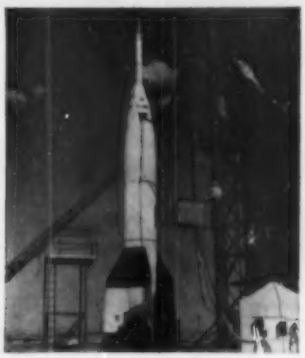


PROPULSION The highest specific impulse in the history of rocket flight was obtained by a G-E designed rocket engine—a preview of more powerful rocket engines for the guided missiles of the future.

GUIDANCE General Electric's contributions in programmed, radio and inertial guidance have helped industry provide our Armed Services with reliable guidance systems.



SYSTEMS TEST Over one hundred surface-to-surface missiles, designed for guided missile research and development, have been flight tested by General Electric personnel for the Army Ordnance Corps.

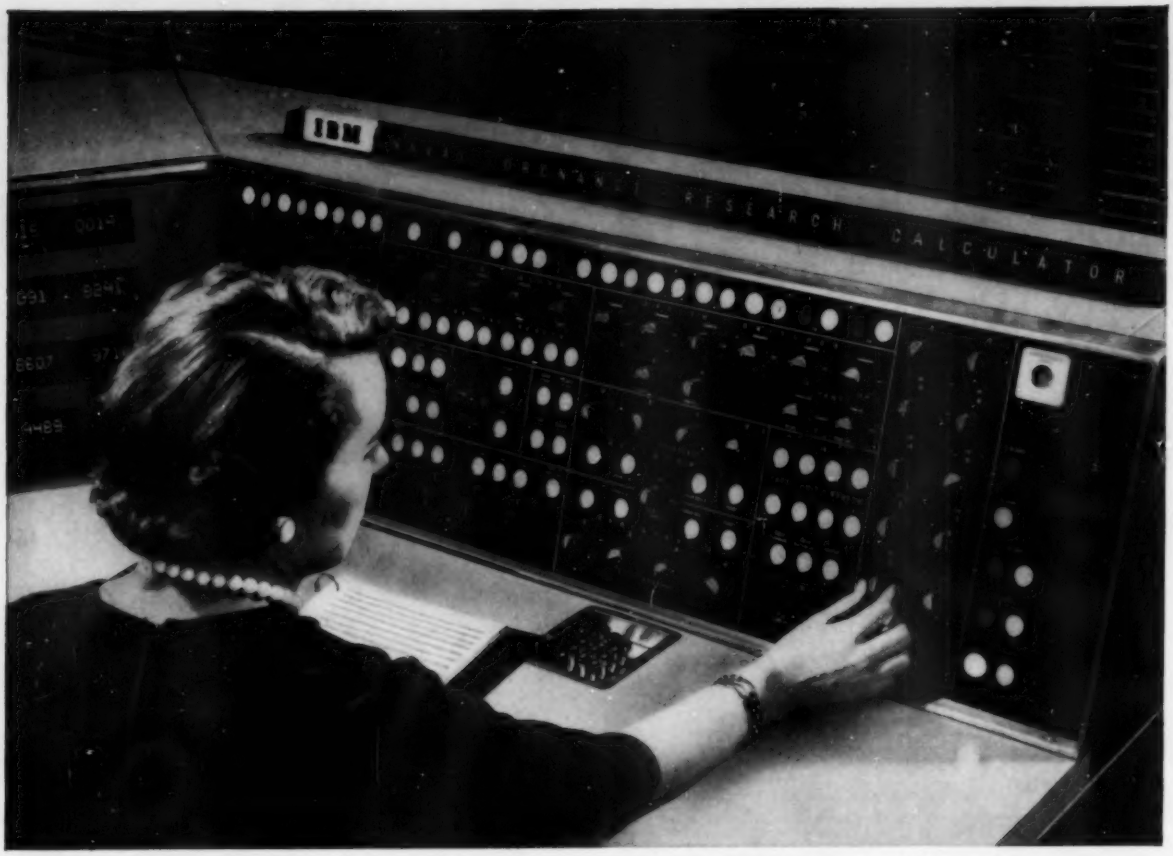


AIR FRAME Problems in flying at record speed of 5,000 mph and record altitude of 250 miles were encountered in Project Bumper, where a Wac Corporal rocket was "bumped" from a V-2 in full flight.

For detailed information on how G.E.'s experience in complete guided missile systems as well as sub-system development and production can aid your missile project, contact your nearest G-E Apparatus Sales Office. Section 224-2, General Electric Company, Schenectady 5, N. Y.

Progress Is Our Most Important Product

GENERAL ELECTRIC



IBM *announces*

the most **POWERFUL**

of all electronic giants . . . the

NORC

Designed and built by International Business Machines Corporation for the United States Navy, the NORC (Naval Ordnance Research Calculator) is now working to help build up America's strength.

NORC is the fastest, most powerful electronic calculator in the world.

This "giant" among electronic giants sets a new pace for an age where supersonic speeds have become commonplace. NORC's abilities are truly phenomenal.

A floating decimal, high-precision calculator, NORC can solve problems of terrific complexity at speeds many times faster than any other electronic data processing machine the world has ever known—even faster than other outstanding giants produced by IBM.

NORC is only one example of IBM's acknowledged leadership in the rapid advance of electronic fact-finding machines. IBM makes a complete line of EDPM—Electronic Data Processing Machines—for large and small businesses, for scientific research, for engineering calculations, for handling routine accounting work faster and at less cost.

what the **NORC** *can do*

IN 31 MILLIONTHS OF A SECOND

multiply two thirteen-digit figures . . .

23689.12941062
X 867124051.0296
20541413859901.255052174352

and automatically place the decimal correctly.

IN ONE SECOND . . .

"read" or "write" more than 70,000 digits from a magnetic tape unit . . . roughly equal in recording speed to 14,000 typists working at one time.

IN ONE DAY . . .

perform hundreds of millions of operations without a single error—the equivalent of 1,000 people computing all their lives without making a mistake.

IBM
TRADE-MARK

WORLD'S LEADING PRODUCER OF ELECTRONIC ACCOUNTING MACHINES

INTERNATIONAL BUSINESS MACHINES CORP. • 590 MADISON AVENUE, NEW YORK 22, N. Y.

IMPORTANT NEWS TO ORDNANCE MANUFACTURERS

KAISER ALUMINUM NOW PRODUCES

Erie forging plant will provide ordnance manufacturers with continuing supply of high quality forgings plus nationwide service

RECENTLY we acquired one of the nation's three major aluminum forging plants on a long term lease. The plant is located on a 57-acre site in Erie, Pa.

This modern, diversified plant, built in 1943, has long been known for the high quality of the aluminum forgings produced. Forging equipment includes a wide variety of hammers and presses fully complemented by engineering, die sinking, laboratory, and inspection facilities.

The Erie plant produces aluminum die forgings from the smallest size up to 150 pounds as well as hand forgings up to 700 pounds. It has a rated capacity of 12 to 15 million pounds per year.

The plant is manned by highly skilled men with years of experience in aluminum forgings.

Better service for ordnance manufacturers

For years we have been a major supplier of aluminum in many forms to ordnance manufacturers. The ac-

Setting the pace . . . in growth, quality and service

FORGINGS

quisition of the Erie plant makes it possible for us to bring important benefits to these customers.

Sales service—The addition of aluminum forgings to our wide range of mill products enables our nation-wide sales force to increase its service to our customers. Personal attention is given to every order from the time it is received until the forging is delivered to the customer.

Engineering service—We are increasing the present staff of experienced engineers. These men are highly skilled in die and forging design in the ordnance field and are available for customer consultation.

Quality control—Trained laboratory personnel, using the most modern testing methods and equipment, assure highest quality forgings to meet the rigid specifications of the ordnance industry.

Production control—The most modern methods of production control are employed to expedite material flow, die making, forging and finishing operations, thus maintaining shipping schedules.

Another major step in Kaiser Aluminum Expansion

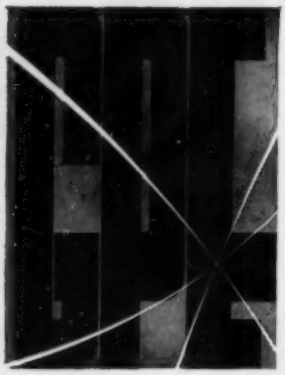
As the eleventh major Kaiser Aluminum plant, the Erie forging works will carry forward our program for further integration and diversification of operations and products.

We have been producing forging stock at our rod, bar and wire plant at Newark, Ohio for a number of years. We will continue to supply the industry in addition to meeting our own needs for quality forging stock.

Our increased product diversity, greater production capacity and unsurpassed sales and engineering service, ideally equips us to work with ordnance manufacturers.

For immediate attention to your aluminum forging needs, contact any Kaiser Aluminum sales office listed in your telephone directory. Kaiser Aluminum & Chemical Sales, Inc. *General Sales Office,* Palmolive Bldg., Chicago 11, Illinois; *Executive Office,* Kaiser Bldg., Oakland 12, California.

Kaiser Aluminum



SERVES INDUSTRY THROUGH *coordinated*

The producing companies of General Precision Equipment Corporation are engaged in the development, production and sale of advanced technological products. These products all have a broad common base: 1) they represent precision equipment in some form; 2) they derive from similar fields of technical competence; 3) they save labor, increase productivity, or achieve results which cannot be attained with even limited use of on-the-spot manpower.

A general view of the technical capacities of the GPE Producing Companies is given in the chart. But the chart cannot show the very close interrelation of these capacities nor the highly flexible application of facilities, techniques and capabilities which exists among these companies. This is achieved through GPE's basic operating policy—Coordinated Precision Technology.

GPE Coordinated Precision Technology operates in all areas—in research, development and manufacture. The record of the GPE Producing Companies in solving advanced technological problems and meeting the demand for high speed, precision, reliability, light weight and compactness at competitive prices is the result of this coordination, the constant application of the newest and most highly advanced techniques, and unremitting insistence on highest quality.

Perhaps the most conspicuous advantage of GPE Coordinated Precision Technology is that the concept and development of equipment and systems, and of solutions to the underlying technical problems, are not restricted by being confined to the specialized techniques of a particular field. In short, GPE Coordinated Precision Technology permits each company to seek the optimum solution for the customer by the application of all relevant techniques within the total capacities of the entire group. Address inquiries to:

GENERAL PRECISION EQUIPMENT CORPORATION
92 GOLD STREET, NEW YORK 38, NEW YORK

CAPACITIES OF THE GPE PRODUCING COMPANIES

- PRECISION MECHANICS and CERAMICS
- ELECTRICAL EQUIPMENT and COMPONENTS
- ELECTRONICS
- HYDRAULICS and LIQUIDS HANDLING
- PROFESSIONAL and INDUSTRIAL TELEVISION EQUIPMENT
- INSTRUMENTATION
- SERVOS and CONTROLS
- AUTOMATIC COMPUTERS and COMPONENTS
- ULTRASONICS
- RADAR and MICROWAVE
- MOTION PICTURE and SOUND EQUIPMENT
- OPTICAL DEVICES

Over **2200** scientists, engineers, draftsmen, testers and other technical personnel in the GPE Companies work in the fields covered by this chart.

THE PRODUCING COMPANIES

Singer — INTERNATIONAL PROJECTOR CORPORATION—BLOOMFIELD, N. J.

Peerless — J. E. McAULEY MFG. CO. CHICAGO

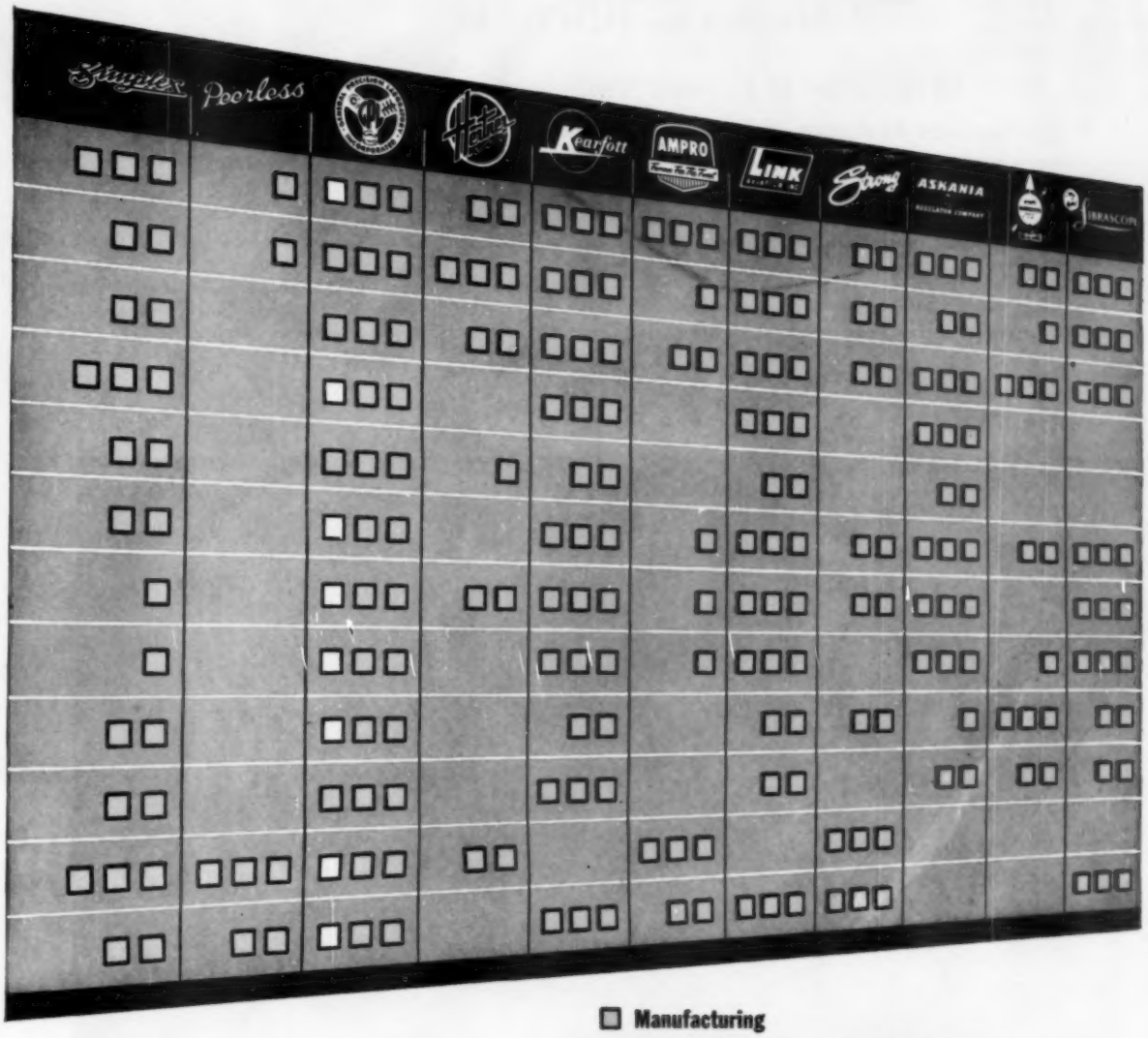
GPL — GENERAL PRECISION LABORATORY INCORPORATED—PLEASANTVILLE, N. Y.

Hertner — THE HERTNER ELECTRIC COMPANY—CLEVELAND

Kearfott — KEARFOTT COMPANY, INC. LITTLE FALLS, N. J.

One of a series telling
how the producing companies of
General Precision Equipment Corporation
are contributing to America's progress.

precision technology



- □ Manufacturing
- □□ Manufacturing and product development
- □□□ Manufacturing, product development and research
- □□□ Pilot manufacturing, product development and research

AMPRO CORPORATION
CHICAGO

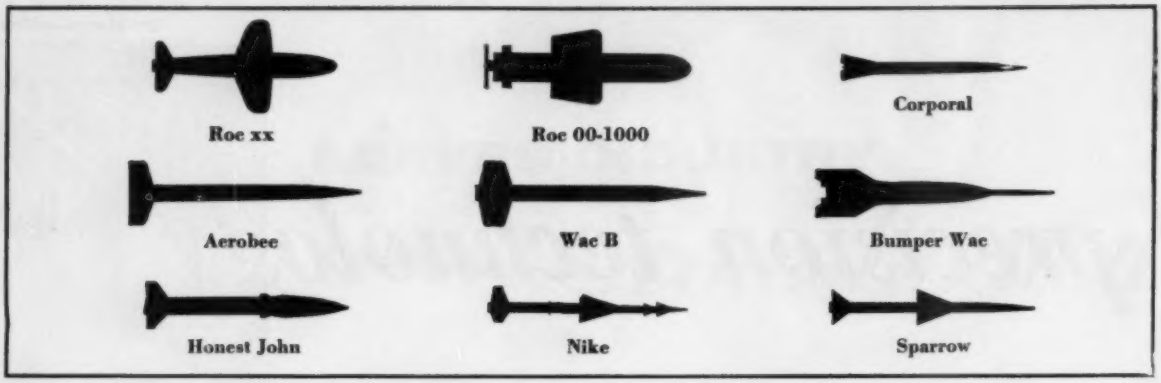
LINK AVIATION, INC.
BINGHAMTON, N. Y.

THE STRONG ELECTRIC
CORPORATION—TOLEDO

ASKANIA REGULATOR
COMPANY—CHICAGO

SUDWORTH MARINE
NEW YORK

LIBRASCOPE, INCORPORATED
GLENDALE, CALIFORNIA



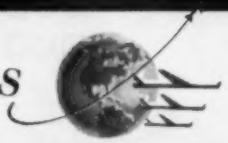
Missiles by DOUGLAS

A box score of 15 years continuous participation in designing and building guided missiles for the Air Force, Army and Navy

Already key cities have the protection of a guided missile which can destroy the swiftest stratospheric bombers. This is Nike, *operational* result of long and versatile missile experience.

Douglas association with rockets and guided missiles has seen this company at work with other industrial leaders and our Armed Forces—to move missile development from a dream of push-button warfare to a solid reality. You saw it in the Bumper Wac research rocket, world altitude champion, in Honest John—field artillery rocket with high explosive or atomic wallop—in missiles of every type . . . air to air . . . air to ground . . . ground to ground . . . ground to air.

Douglas leadership in rocket airframe design has helped give us *operational* missiles in a relatively short span of time. Security cloaks even greater advances which are now on the way.

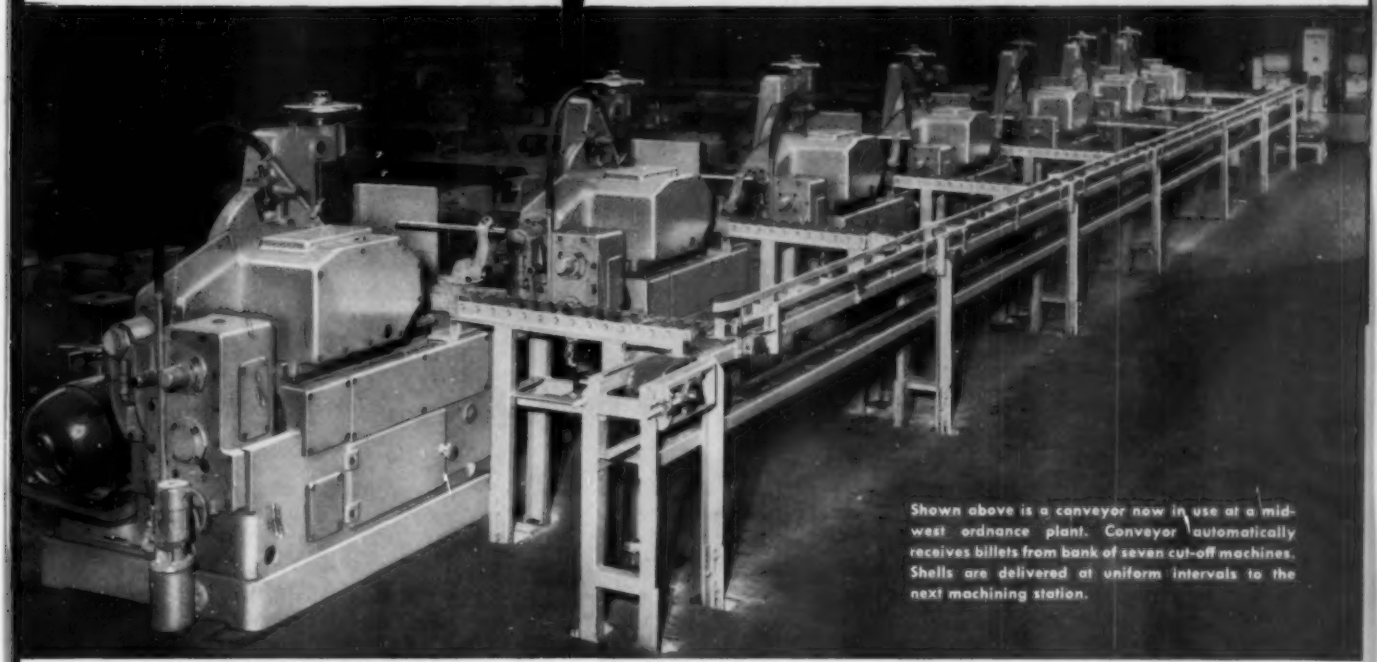
Depend on *DOUGLAS*  **First in Aviation**

"PRACTICAL ENGINEERED" CONVEYORS... now designed and built to fit your needs

IMPORTANT PART OF AN EXPANDED BUILDING SERVICE FOR AUTOMATION EQUIPMENT

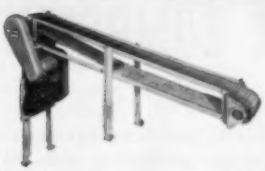
The Process Equipment Division of the W. F. & John Barnes Company now provides complete facilities for designing and fabricating standard or special conveyor units and systems. The four units illustrated are typical of the hundreds of conveyor installations designed and built from standard components to meet the exact need of the particular job to be done. Every Barnes unit is a "tailor-made" system that is "practical-engineered" to increase work handling efficiency by eliminating the more hazardous and laborious manual operations.

Here at Barnes, you'll find the varied engineering and creative skills, plus over 75 years of machine building background, to help you solve many troublesome production problems. And, because all planning, engineering, and manufacturing efforts are closely coordinated, you have available a complete "Automation Equipment Service" from one convenient source.

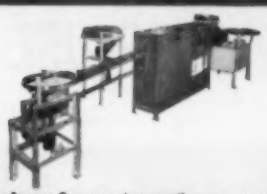


Shown above is a conveyor now in use at a mid-west ordnance plant. Conveyor automatically receives billets from bank of seven cut-off machines. Shells are delivered at uniform intervals to the next machining station.

A leading automotive manufacturer uses this Barnes Conveyor to carry cast iron chips away from machine tools. Chips are carried on a heavy drag-type conveyor-elevator and dropped in a tote box.



Shown here is a wire-mesh type, variable speed conveyor designed for carrying small work parts from a machine. It is widely used for general work-handling and can be built to handle the required length and width of the workpiece.



Here is a Barnes Conveyor in operation on an appliance production line. Metal cylinders are moved by the conveyor through a washer to the next point of operation.

ASK FOR AN ANALYSIS OF YOUR WORK-HANDLING PROBLEMS

Find out how these unique creative and specialized resources can help you cut costs. Your problem will be given expert and individual attention.

GET THIS *NEW* BROCHURE

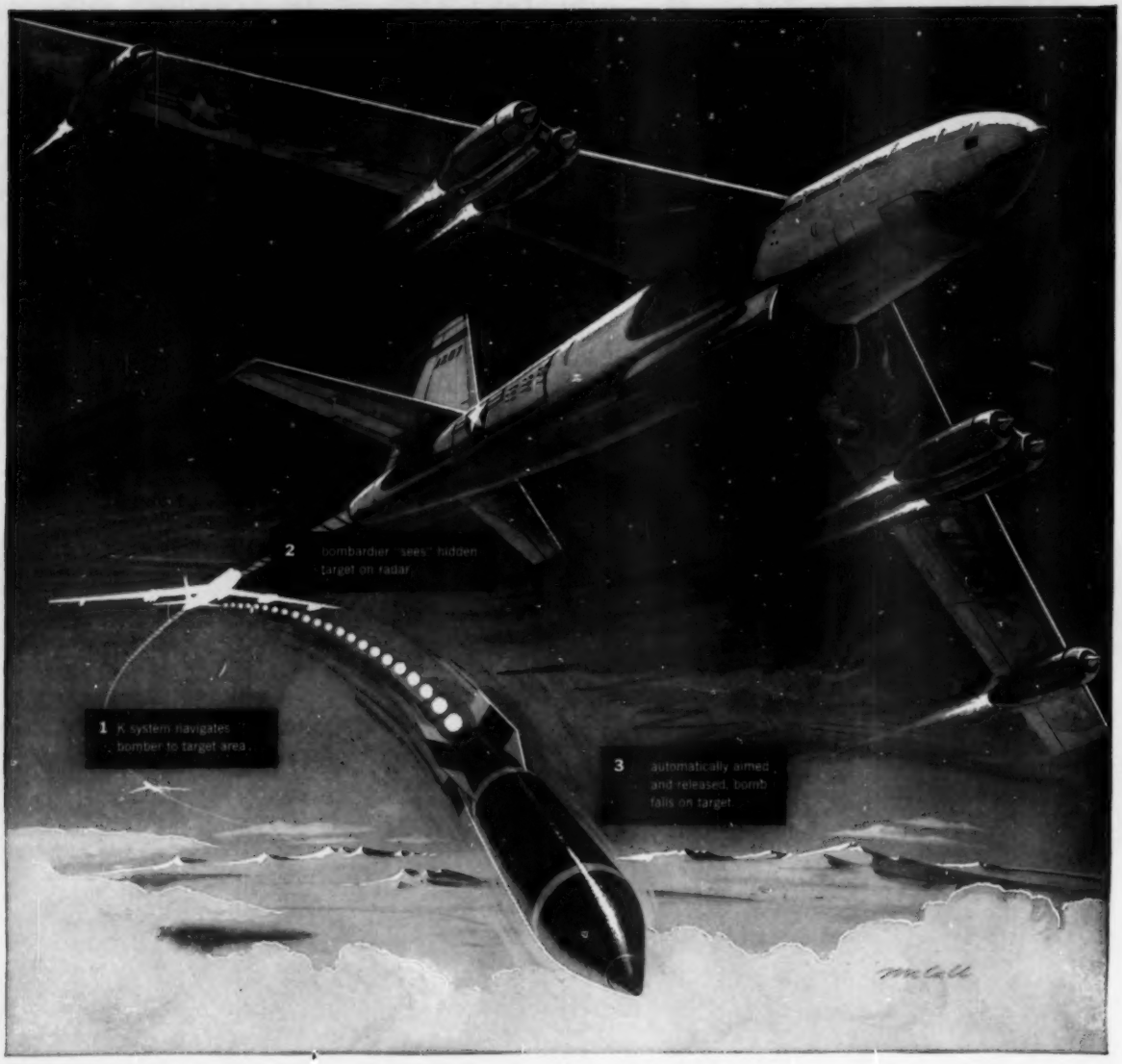
Write today for copy of Conveyor Units and Systems. You'll find 27 solutions to material handling problems.

W. F. & JOHN BARNES

W. F. & JOHN BARNES COMPANY *Process Equipment Division*

308 SOUTH WATER STREET • ROCKFORD, ILLINOIS

BUILDERS OF BETTER MACHINES AND EQUIPMENT SINCE 1872


2 bombardier "sees" hidden target on radar
1 K system navigates bomber to target area
3 automatically aimed and released, bomb falls on target

USAF DESTROYS UNSEEN TARGETS; PLANES USE RADAR BOMBSIGHT

THE STORY BEHIND THE STORY:

■ You've read headlines like the one above, reporting the precision of Air Force bombing—during tests. Within hours after an aggressor attack, you would read them again—reporting deadly counteraction. Night or day, regardless of weather, America can carry out its policy of instant retaliation to any aggressor—in any part of the world.

■ Now in large-scale production, the Air Force K Bombing System combines automatic navigation with all-weather identification and bombing of any target. With the aid of the Sperry Gyropilot* Flight Control and the K System, the crew flies the high-speed bomber to the target area. Using the Sperry-designed Bombing Navigational Computer, the bombardier locates the target optically, or if hidden, by radar. The effects of speed, altitude and wind on the falling bomb are automatically computed, enabling the bombardier to score direct hits. In simplifying the complex job of bombing at extreme altitude from high speed jets, the K System permits more time and flexibility on the bomb run . . . more certainty of "mission completed."

■ There's little resemblance between this automatic "brain" and the first bombsight developed by Sperry for use in World War I—a simple telescope and range scale no larger than an egg beater. But both were made possible because a military-industry team anticipated the needs of modern defense—then met those needs with a strategic bombing program which authorities credit with helping to prevent a new global war.

*T. M. REG. U.S. PAT. OFF.

SPERRY GYROSCOPE COMPANY

DIVISION OF THE SPERRY CORPORATION • GREAT NECK, N. Y.

it makes every step a safe step

You'll find safety signs posted all through any well-run plant. But usually nothing about underfoot safety. Yet sure footing should be a key factor in any plant-wide safety program.

Millions of workers need the walking-working safety provided by Blaw-Knox Electroforged® Steel Grating. Rigid, built in one piece, with non-slip twisted crossbars, it makes ideal floors, platforms, walkways, catwalks and stair treads. It is easy to install and maintain.

In addition to providing underfoot safety, Blaw-Knox versatile steel grating protects danger spots throughout a plant. For example, it makes a safe cover for an open pit or light well, a protective guard for a fan, a sturdy section of shelving. And it provides maximum open area — for added ventilation; light and see-ability.

Both indoors and outdoors, throughout all industry, Blaw-Knox Electroforged Steel Grating and Stair Treads make any plant a safer, better place to work.

Steel grating, however, is only one of many Blaw-Knox contributions to provide safer working conditions, improve production, reduce costs, make better products possible.

Among the various products and services listed below, you may readily find several that can prove a profitable investment for your business.

BLAW-KNOX COMPANY
Farmers Bank Building • Pittsburgh 22, Penna.

before you buy, see if Blaw-Knox makes it

BLAW-KNOX

Blaw-Knox Equipment Division
Pittsburgh 38, Pa. and Elyria, Ohio
Chemical and Process Equipment
Clamshell Buckets
Gas Cleaning Equipment
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Radio, TV and Transmission Towers
Road Paving Machinery and Construction Equipment
Steel Forms for Concrete Construction
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Ordnance Equipment

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Loops

if you need...

Hooks

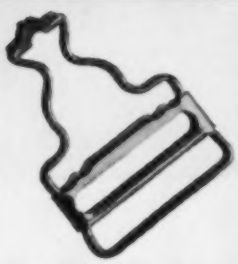
Wire Forms

in a variety of metals, to fit your specifications. Precision made on our automatic machines in round, flat and special-shaped wire.

Intricate Shapes

Buckles

Assemblies

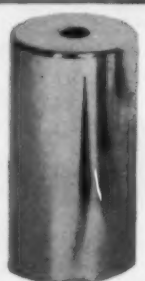


Slide Loops

Metal Stampings

of ferrous or non-ferrous materials. More than 150 presses from 5 to 150 tons are at your service.

Heavy Stampings



. . in steel

Deep Drawings..

requiring close tolerances. Many items now machined can be deep-drawn at lower cost, faster. Our process permits elimination of annealing between steps in many instances.

. . . we can supply them

Our integrated production service includes complete metal treating and finishing facilities. An experienced engineering staff is available to design the tools and dies required to produce the items you need, economically, speedily. Send your specifications for our quote.

Write for Catalog No. 100.

Eastern Tool & Mfg. Co.

Belleville 9, N. J.

. . in copper

. . in aluminum

Continental Red Seals are ENGINEERED AND BUILT for LONGER LIFE . . . LOWER OVER-ALL COST

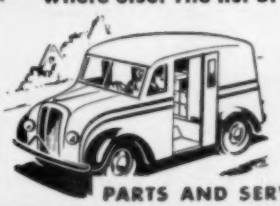
TRANSPORTATION GASOLINE ENGINES

Model	Cyl.	Bore	Stroke	Displ.	Bare Engine H.P.
N4062	4	2⅛	3½	62	26 @ 3400 RPM
Y4069	4	2½	3½	69	28 @ 3400 RPM
Y4091	4	2⅜	3½	91	36 @ 3400 RPM
F4124	4	3	4⅛	124	47 @ 3200 RPM
F4140	4	3 3/16	4⅛	140	52 @ 3200 RPM
F4162	4	3 7/16	4⅛	162	58 @ 3200 RPM
F6186	6	3	4⅛	186	77 @ 3500 RPM
F6209	6	3 3/16	4⅛	209	90 @ 3500 RPM
F6226	6	3 5/16	4⅛	226	99 @ 3500 RPM
M6271	6	3⅜	4⅛	271	97 @ 3000 RPM
M6290	6	3¼	4⅛	290	108 @ 3000 RPM
M6330	6	4	4⅛	330	125 @ 3000 RPM
M6363	6	4	4 13/16	363	138 @ 3000 RPM
K6271	6	3⅜	4⅛	271	115 @ 3200 RPM
K6290	6	3¼	4⅛	290	123 @ 3200 RPM
K6330	6	4	4⅛	330	145 @ 3200 RPM
B6371	6	4½	4⅝	371	124 @ 3000 RPM
B6427	6	4 5/16	4⅞	427	142 @ 3000 RPM
T6371	6	4½	4⅝	371	144 @ 3000 RPM
T6427	6	4 5/16	4⅞	427	169 @ 3000 RPM
U6501	6	4½	5¼	501	178 @ 2600 RPM
R6513	6	4½	5⅛	513	180 @ 2800 RPM
R6572	6	4¼	5⅛	572	200 @ 2800 RPM
R6602	6	4⅛	5⅛	602	212 @ 2800 RPM
S6749	6	5⅛	5½	749	250 @ 2800 RPM
S6820	6	5⅛	5½	820	277 @ 2800 RPM

TRANSPORTATION DIESEL ENGINES

Model	Cyl.	Bore	Stroke	Displ.	Bare Engine H.P.
TD6427	6	4 5/16	4⅞	427	116 @ 2400 RPM
RD6572	6	4¼	5⅛	572	162 @ 2400 RPM
SD6802	6	5 1/16	5½	802	225 @ 2200 RPM

It is a significant fact that Red Seal transportation engines find their widest acceptance in the really tough jobs where extra stamina is a prime consideration. You see more and more of them in heavy-duty highway trucks and tractors, both as original equipment and as replacements for other makes. You see them in buses and taxicabs, and in door-to-door delivery vehicles where frequent starts and stops, and protracted idling time, impose problems found nowhere else. The list of Red Seal gasoline and Diesel models at the left includes the one best power plant for every transportation job.



PARTS AND SERVICE EVERYWHERE

CONTINENTAL MOTORS® Powerful as the Nation AMERICA'S STANDARD

S.A.E. 1905 GOLDEN ANNIVERSARY 1955

Continental Motors Corporation

MUSKEGON • MICHIGAN

6 EAST 45TH STREET, NEW YORK 17, NEW YORK • 6218 CEDAR SPRINGS ROAD, DALLAS 9, TEXAS • 3817 SOUTH SANTA FE AVENUE, LOS ANGELES 58, CALIFORNIA • 910 SOUTH BOSTON STREET, ROOM 1008, TULSA, OKLAHOMA • 1252 OAKLEIGH DRIVE, EAST POINT (ATLANTA) GEORGIA

The Facts Behind Allis-Chalmers Leadership in Torque Converter Tractors

***Fourteen* years of experience . . . *eight* years with production models . . . *thousands* of torque converter tractors out in the field . . . *millions* of operating hours on every kind of work.**

TODAY'S tractor owners have given their "stamp of approval" to torque converter drive—as a key factor in the new standards of tractor performance they need to meet today's high production demands. Here's why—

Automatic Matching of speed and pull to load and terrain conditions . . . more dirt moved every hour, day in and day out.

Hydraulically cushioned protection for engine, clutch, transmission, rear end. The entire tractor lasts longer! That means less downtime, lower maintenance costs.

Operators love it! Allis-Chalmers torque converter tractors are so easy to handle (most shifting is eliminated) that operators do a top-notch job all day long.

Yes, today's most experienced users are demanding and buying torque converter tractors . . . *and in this, Allis-Chalmers leads the way.*

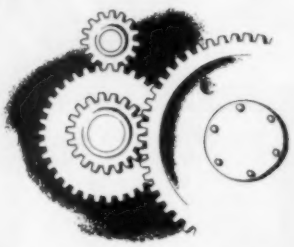
But, remember, you don't buy just one feature . . . you buy a *tractor*, with torque converter drive designed as a matched part of the entire machine. This advanced drive is only *one* of the many outstanding features that have been developed by Allis-Chalmers research and engineering.

Here are other examples of advanced engineering

All-Steel Box-A Main Frame with one-piece, rear-end housing gives improved weight distribution, soaks up shocks, provides better equipment mounting, greater servicing ease . . . longer equipment life.

Service Simplicity of Unit Construction — Power drive components can be easily removed, repaired or replaced without disturbing adjacent parts . . . saving time and money.

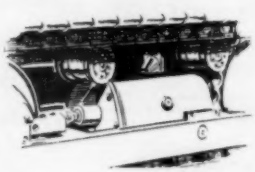
"Live" Sprocket Shafts — "Live" shafts with straddle-mounted bearings permit small, more serviceable seals. Double reduction final drives with smaller gears and shorter, heavier shafts mean extra ground clearance, better alignment, longer life.



1,000-Hour Lubrication — Tapered roller bearings and positive seals on truck wheels, idlers, support rollers and final drives extend lubrication intervals, cut downtime.

Hydraulic Booster Steering — Gives operator small tractor maneuverability with new ease. In addition, self-energizing brakes which take hold with a firm, uniform grip, provide exact control and sure safety with less pedal pressure.

True-Dimension Track provides maximum ground contact . . . plus the right design, the best steels for every job condition . . . heat-treated for long life with the industry's newest, most complete facilities.



Oil-Enclosed Track Release Mechanism — Operates in oil, seals out dirt and moisture, always in working condition to provide positive protection.

Technical and practical experience like this, coupled with the most modern heat-treating and manufacturing facilities, are always available to Ordnance Engineers for every phase of product design, development and manufacture.

ALLIS-CHALMERS

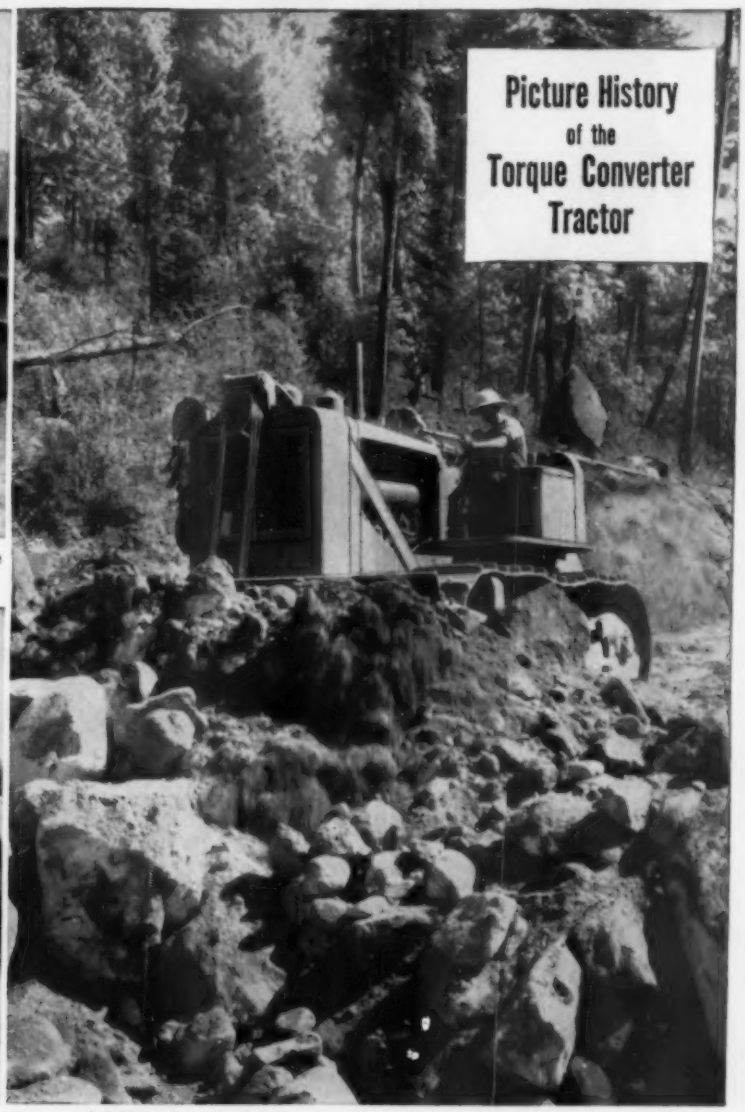
TRACTOR DIVISION · MILWAUKEE 1, U. S. A.

1940 THE FIRST tractor in the world with torque converter drive.

WORLD WAR II—The torque converter equipped M-4 military tractor, built by Allis-Chalmers.

1947 THE HD-19 proved the value of torque converter drive for big production.

1951 THE HD-20, 175 net engine hp, most productive tractor in the business.



1954 THE HD-15C, 135 net engine hp, brings advantages of torque converter to a new range of work.

HAPPY SAFER LANDINGS!

Bigger, heavier and faster—today's carrier-based aircraft take off and land on the same carrier their World War II ancestors used, but it's a lot safer these days.

Thanks to your Navy's canted deck principle . . . to the modern catapults and arresting gear . . . the accident rate has been dramatically lessened.

E. W. Bliss Company is proud to be a member of the research and development team that makes these life-saving advances possible, proud to manufacture catapulting and arresting gear for the Navy's finest ships, proud to have its maintenance specialists chosen to service this equipment on aircraft carriers.

Easier getaways, too. Steam catapults, built by Bliss in cooperation with the U. S. Navy, launch jets in any direction relative to the wind.

BLISS ***. . . for contract ordnance projects***

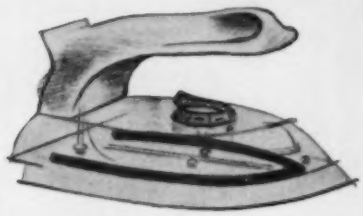
E. W. BLISS COMPANY

General offices: Canton, Ohio

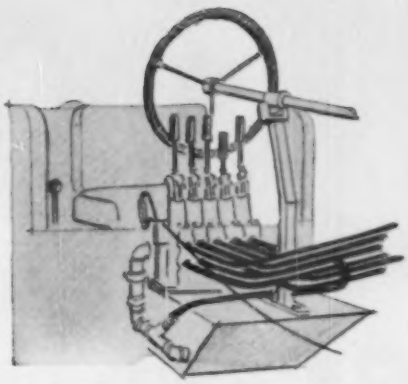
• CATAPULTS • ARRESTING GEAR
• MACHINE GUNS • NAVAL GUN MOUNTS • SPECIAL MACHINERY

BUNDY TUBING COMPANY

FROM *the Bundy Sketchbook*
TO *jog a designer's imagination*



SHEATH FOR HEATING ELEMENT IN HAND IRON

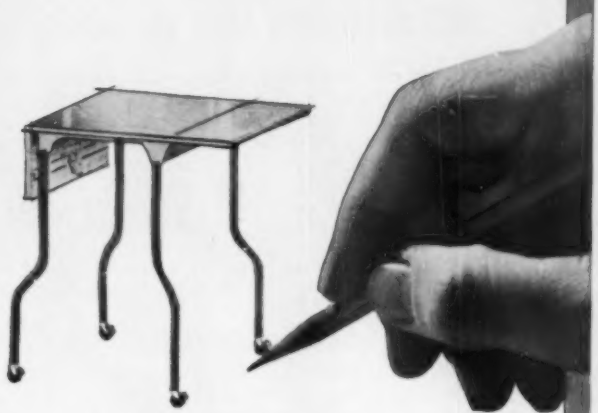


HYDRAULIC CONTROL GROUP IN ROAD GRADER

REMARKS Designing a new product? Or redesigning an old one? Why not avoid delays, expense by turning your tubing headache over to our engineering experts. They offer you a wealth of problem-solving experience, plus the priceless bonus of Bundyweld, the only tubing double-walled from a single strip (see below).

WRITE today for catalog or for help in developing your tubing application.

BUNDY TUBING COMPANY
DETROIT 14, MICHIGAN



FRAME FOR TYPING TABLE

WHY BUNDYWELD IS BETTER TUBING

Bundyweld starts as a single strip of copper-coated steel. Then it's . . .

continuously rolled twice around laterally into a tube of uniform thickness,

and passed through a furnace. Copper coating fuses with steel. Result . . .

Bundyweld, double-walled and brazed through 360° of wall contact.

BUNDYWELD TUBING®

DOUBLE-WALLED FROM A SINGLE STRIP

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High endurance limit
Extra-strong
Shock-resistant
Ductile
Lightweight
Machines easily
Takes plastic coating
Takes plating
Bright and clean
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ATOMIC ENERGY

PRODUCTION EXPANDED

A major construction program involving the expansion of the Atomic Energy Commission's feed-materials production and processing plants at three sites was recently announced. The total cost of the program is estimated at approximately $67,000,000.

It involves construction of a new facility in the St. Louis, Mo., area and expansion of existing facilities at the Feed Materials Production Center at Fernald, Ohio; the feed-materials facilities at St. Louis; and the feed plant at the gaseous-diffusion plant at Paducah, Ky.

The function of the St. Louis and Fernald feed-materials plants is to convert high-grade uranium ore and concentrates into highly purified uranium compounds or metal. The Paducah facilities will contribute to the Commission's capacity to convert uranium into forms useful to its program.

The new facilities in the St. Louis area, estimated to cost approximately $39,800,000, will be operated by the Mallinckrodt Chemical Works and will constitute an expansion of the facilities now being operated by Mallinckrodt for AEC in St. Louis. Some expansion will occur at the existing refinery, but it will be necessary to locate most of the planned facilities at a new site. The new facility will be capable of extracting and purifying uranium from uranium-bearing concentrates. The plant will cost an estimated $33,300,000 and will consist of a purification unit, a uranium chemical unit, uranium foundry, and suitable auxiliary facilities necessary for production operations. When completed, a permanent operating force of about 1,300 will be required.

In addition to the new plant, the program calls for a $6,500,000 expansion of the existing feed-materials plant in St. Louis. This expansion consists of modification of some of the existing buildings and equipment, construction of a new building, and expansion of auxiliary facilities and utilities.

Expansion of the Feed Materials Production Center at Fernald, Ohio, will cost an estimated $20,100,000. The Feed Materials Production Center is operated by the National Lead Company of Ohio for AEC.

At Paducah, the program involves a $7,000,000 expansion. It includes enlargement of an existing building and equipment, and construction of a new building with approximately 4,000 square feet of floor space. The facilities at Paducah are

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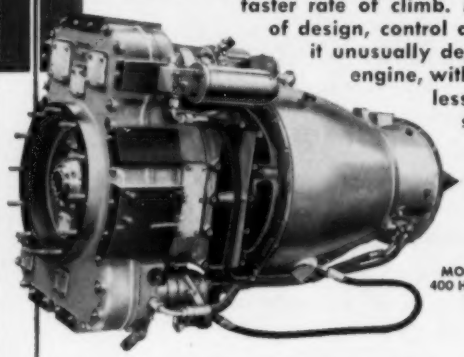

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ATOMIC AIRCRAFT

In another five years the principal problems incident to the production of atomic-powered aircraft may be solved, according to British nuclear experts. Such planes may actually be flying within ten or fifteen years.

The Atomic Energy Authority (the central nuclear agency in Britain) has disclosed that research work is being conducted at Harwell into two or three different types of atomic nuclear reactors. Several private firms, among them Rolls Royce, have assigned their own engineers to study developments at the research establishment.

One problem—the development of a metal strong enough to withstand the terrific heat and the radioactivity generated by an atomic reactor—is well on the way to being solved, according to the Authority.

The chief difficulty still outstanding is that of harnessing within the confines of a small aircraft the power necessary to propel it.

It is likely that the atomic engine finally developed will be a turbojet rather than a propeller type.

It is also expected that the first aircraft to be equipped with nuclear power will be a large flying boat. An aircraft of this size is necessary because of the heavy screening of the fissile material, and it would increase the safety factor in the event of a crash, since salt water has been found to be an excellent neutralizer.

Another advantage of a seaplane would be its landing facility. Because of the weight of the reactor and the thick shielding around it, any early atomic aircraft is bound to be heavy. It will be as heavy landing as taking off, since the fuel used will be negligible, and for a land-based aircraft this could impose an enormous strain on runways—to say nothing of the undercarriage. Use of flying boats would eliminate this problem.

Later on, of course, smaller and more efficient engines would be developed. Already early estimates of the weight of atomic-driven aircraft have been nearly halved from the original estimate of 230 tons.

LARGE SHIP REACTORS

Two projects for the development of nuclear propulsion for large naval vessels are now under way. Research and development work on a reactor suitable for large ship propulsion has been assigned to Westinghouse Electric Corporation, and $1,250,000 has been authorized for this work for the current fiscal year.

Separate design studies of large nuclear-powered ships have recently been undertaken by the Newport News Ship-

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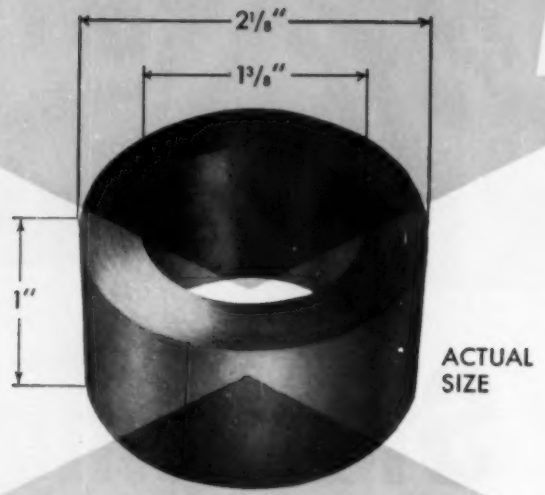

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Atomic Energy

building and Dry Dock Company at Newport News, Va., and the Bethlehem Steel Company at Quincy, Mass., both under contract with the Navy Bureau of Ships.

The pressurized water reactor type has been selected for this project. The reactor development work was assigned to the Westinghouse company because of its wide experience with this reactor type. The company is developing the large-scale central station power reactor for the AEC-Duquesne Light Company project at Shippingport, Pa. The ship reactor work will be done at the AEC's Bettis Plant, Pittsburgh, which is operated by Westinghouse.

SHIP DECONTAMINATION

Salt water, hundreds of tons of it sprayed with an intensity exceeding that of a tropical rainstorm, is one effective method of protecting ships against contamination by radioactive particles. This new defensive equipment in the atomic age will be installed in all new British warships. It consists of a number of nozzles distributed about the ship through which salt water can be sprayed over all weather surfaces.

Trials recently carried out in the Royal Navy's experimental cruiser H.M.S. CUMBERLAND involved 50 nozzles spraying 300 tons of water an hour over the decks and superstructure.

The experiment proved that fission matter is less likely to adhere to a surface while it is being subjected to a systematic salt-water washdown, and such as does adhere can be removed more speedily from the infected parts.

During the washdown, all openings giving access to the ship's interior are closed, and spraying continues until Geiger-counter tests prove the vessel safe.

The system is considered particularly suitable for the new fast antisubmarine frigates on which working spaces are totally enclosed, even the lookout positions being under plastic domes.

RESEARCH LABORATORY

The Air Force plans to provide for the use of the Pratt & Whitney Aircraft Division of United Aircraft Corporation a facility in connection with a portion of the Aircraft Nuclear Propulsion program. The facility will consist of a research and development laboratory to facilitate Pratt & Whitney effort under contracts with the Department of the Air Force and the Atomic Energy Commission.

The 1955 public works appropriation for the Air Force contains $5,750,000 to provide a site, and to design and build the structures initially required. Equipment will probably increase the cost to about $10 million.

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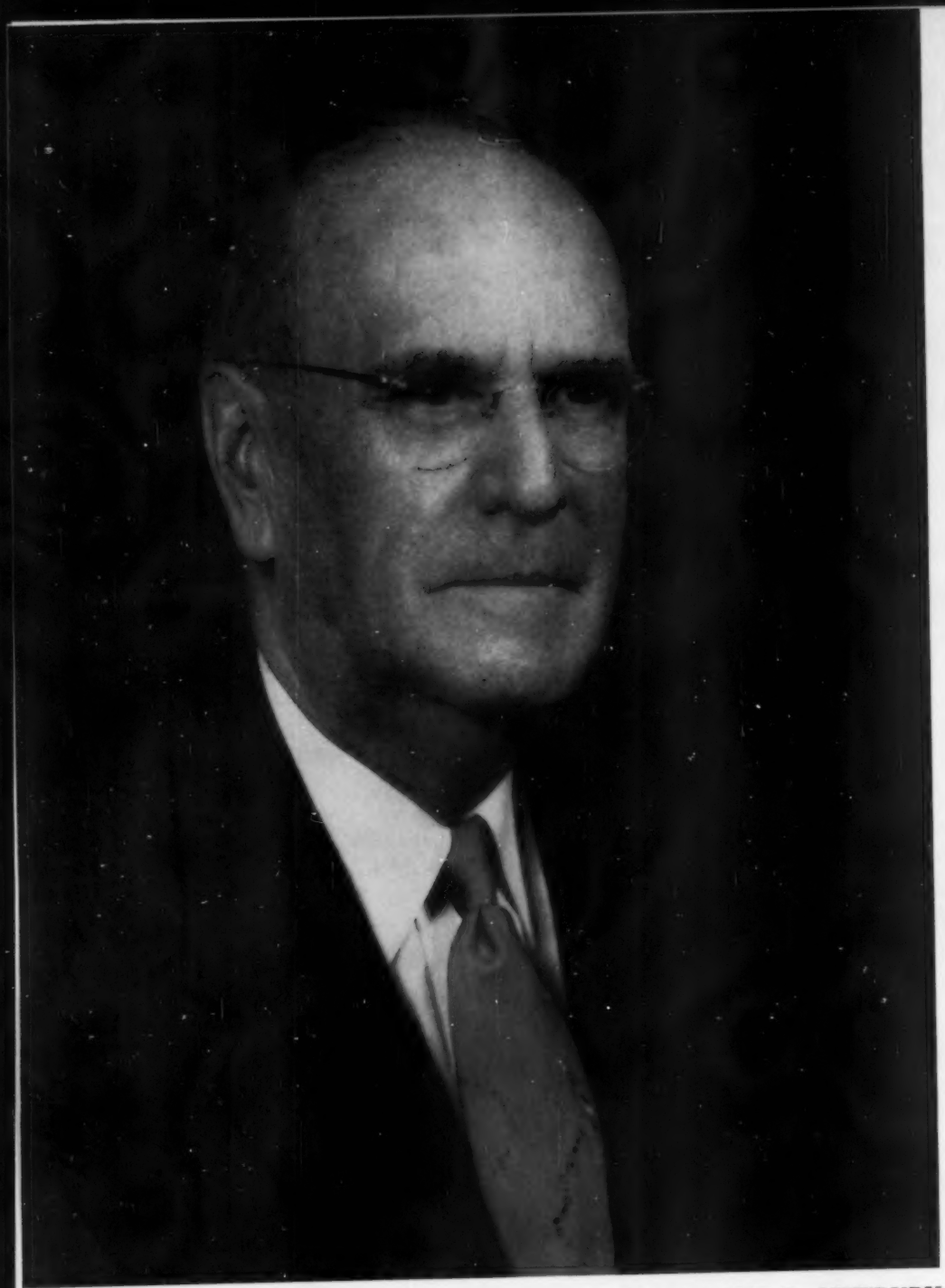
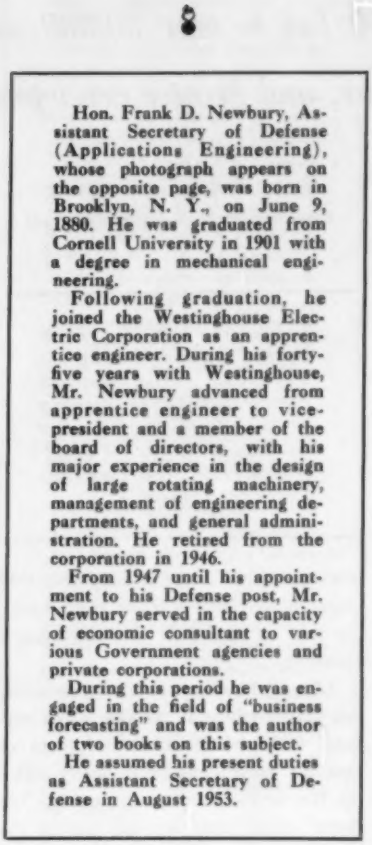


HON. FRANK D. NEWBURY

Assistant Secretary of Defense, Applications Engineering

The Armament Engineer

There Is No Substitute for Trained Manpower in the Armed Forces



Hon. Frank D. Newbury, Assistant Secretary of Defense (Applications Engineering), whose photograph appears on the opposite page, was born in Brooklyn, N. Y., on June 9, 1880. He was graduated from Cornell University in 1901 with a degree in mechanical engineering.

Following graduation, he joined the Westinghouse Electric Corporation as an apprentice engineer. During his forty-five years with Westinghouse, Mr. Newbury advanced from apprentice engineer to vice-president and a member of the board of directors, with his major experience in the design of large rotating machinery, management of engineering departments, and general administration. He retired from the corporation in 1946.

From 1947 until his appointment to his Defense post, Mr. Newbury served in the capacity of economic consultant to various Government agencies and private corporations.

During this period he was engaged in the field of "business forecasting" and was the author of two books on this subject.

He assumed his present duties as Assistant Secretary of Defense in August 1953.

ANY housewife will tell you that the early model washing machine consisted of three major parts—an electric motor, a simple spinning mechanism, and a separate wringer. If anything went wrong, almost any bright boy, accustomed to tinkering with an antiquated jalopy, could repair it.

Washing machines today are fully automatic. But any major breakdown normally requires the costly services of a mechanical engineer. So it is with today's weapons.

The ever-increasing complexity of military armament accents the need for engineerng talent. It requires a great deal more than jalopy experience to operate and maintain such things as pilotless airplanes, radar, rockets, jet-powered aircraft, robot-controlled missiles, and atomic weapons and ammunition.

DURING World War II, carefully selected teams of scientists were rushed to critical combat areas to assist our armed forces in setting up radar defenses, installing telephone systems, fighting fungus, devising more effective ways of destroying underwater obstacles, and finding solutions for problems arising out of certain ultra-high-frequency armament equipment.

These men were highly qualified experts in such fields as radio engineering, electrical engineering, physics, metallurgy, chemistry, mathematics, geophysics, communications engineering, biophysics, biology, and physical chemistry.

Military technology has made giant strides during the past decade. But it is obviously futile to go on designing superweapons if they cannot be serviced properly by highly trained military personnel.

In the event of future hostilities, civilian scientists, even if a sufficient number were available, cannot be spared from research and development work at home to compensate, on some distant battlefield, for the lack of scientific training on the part of men in uniform.

In the wars of past centuries, personal bravery was an essential element in all combat operations. Bravery, of course, is still important. But without highly developed technical skill in the employment of modern atomic-age weapons, courage alone will never result in combat victories.

As one Air Force officer stated recently: "Firepower in the equation of war is approaching a constant factor. In other words, the quantity of firepower is becoming less and less a factor of manpower in the combat area.

"The variable in the equation of war, then, that takes on increasing significance is the ability to apply the firepower, not with numbers of men, but with increased skill. I consider skill in application to include all the quality elements of war, from intelligence to tactics and strategy. And, of course, this quality is embodied in highly trained military people."

THE technical training of men in uniform must be accompanied by the unceasing training of technicians in industry so that they will be capable of discharging their increasingly complex production duties with maximum efficiency.

American industry has a good record in this respect. It is making every effort to recruit and train technical specialists in plants and factories across the country. It is also providing scholarships for the training of likely candidates in our colleges and universities.

The development of sufficient numbers of technically trained combat forces and technically proficient civilian workers is not a task that can be accomplished in a hurry. But it is a critically important task which the American Ordnance Association long has recognized.

For thirty-five years it has taken practical steps to strengthen the Nation's technical manpower for armament preparedness. It will redouble its efforts to foster that scientific knowledge and experience which are indispensable for the Nation's continued security.

Progress in Air Power

The effective altitude of our first-line fighter airplanes has been increased from 35,000 feet to over 50,000, air speeds from 400 to over 700 miles an hour, and greater developments are being readied

Gen. Nathan F. Twining
Chief of Staff, United States Air Force

This address was delivered by General Twining during the Thirty-sixth Annual Industrial Preparedness Dinner Meeting of the American Ordnance Association at the Waldorf-Astoria Hotel, New York City, December 1, 1954.

FIFTY short years ago a trip of six or seven hours' flight from the West Coast could not have been reasonably predicted. To assess the progress we have made, and to peer into the future, we must sometimes look back to see where we have been and how far we have come. Indeed, during these days of Mach numbers and megatons, it is more comforting to look at the past with pride than to look into the doubtful future.

The other day I came across a document which is an aviation milestone. It was entitled, "Signal Corps Specification Number 486," dated December 23, 1907. This paper listed the desired specifications for our first military airplane—then called a heavier-than-air flying machine. To make sure that is was heavier than air, it was forbidden by the specification to have any gas bag attached.

Another of the contract requirements read: "It is desirable that the flying machine should be designed so that it may be quickly and easily assembled and taken apart and packed for transportation in Army wagons." After reading this, I could not help thinking that today a similar requirement might read: "The airplane must be capable of carrying a dozen Army wagons or trucks 500 miles in one hour."

When those of us living in this astounding air age look back just a few years, we marvel at how little we knew then. Probably in fifty more years people will marvel at our ignorance in 1954. There is one thing that most of us have learned from living in this air age—it is that anything is possible.

One of the things that has convinced us that anything is possible is our success with the atom. Development of nuclear power has been closely allied to the development of air power. We now realize that we are within the range of air attack by any enemy and that we can attack any enemy. We now are beginning to realize the tremendous destructive power of nuclear weapons. These are frightening developments, and in some cases fear has overcome reason. Some people blindly damn the airplane and nuclear weapons. Others pretend that this combination does not exist or, that if it does exist, it really is not so very powerful. They say that if we ever do have to fight again, the fight will be decided by traditional tactics and traditional weapons.

I am in complete agreement with the idea that air-nuclear power in war has become a grave threat, not only to our potential enemies but also to us and our allies. I assure you that I sincerely hope it will never have to be used.

Whether technological progress creates new weapons or better ways of living, we can no more stop that progress than we can stop the earth from rotating. We cannot explain it away nor can we ignore it away. The results of progress are here and we must live with them.

If this means that nations at war would lose cities instead of soldiers in a future conflict, it is better that we recognize this reality. This would make it easier for us to put our emphasis on preventing any conflict rather than hopefully and wishfully preparing to fight any next war with weapons and tactics of the last.

WE military men tend to think of technological progress in terms of weapons improvement. Indeed, we must —it is our job. But we in the Air Force can be proud of a unique contribution to peacetime living in America. Our main military tool, the airplane, has become an invaluable part of our American life. This could not have happened without Air Force support of the aviation industry, nor could it have happened without the outstanding work of our scientists.

It is true that American industry is the strength of our Air Force, but it is also true that without American Air Forces we would have virtually no aircraft industry in the United States. Over ninety per cent of all the products of the aircraft industry go to our military Air Forces. This percentage takes

on meaning when you realize that today the aircraft industry is the largest industry in the United States.

The industry rose to that position quickly considering its small and faltering start—one handmade airplane delivered in 1909. The rise is all the more remarkable in view of the air industry's record of stops and starts, with emergency peaks of effort followed by drastic production cutbacks. The parallel history of Air Force ups and downs is no mere coincidence. It is a reflection of the interdependence of the Air Force and the air industry.

IN the meantime, since 1907 the peaceful uses of aviation have equaled its progress as our principal instrument of defense. Its many effects upon the lives of our people are widespread and have come about gradually without the fanfare of wartime achievement.

One effect that is easy to evaluate is the industry's effect on payrolls. The aircraft industry is the largest industrial employer in the United States, hiring over 800,000 people.

Cities throughout the Nation can trace their growth to the aircraft industry. In San Diego and Wichita, almost seventy per cent of those employed by manufacturers are in the aircraft industry. In Los Angeles, almost 170,000 people work in the aviation industry. The effect on our economy and on our society is obvious.

What has the airplane itself done for us? The airplane takes us, our mail, and our freight all over the globe. It does these jobs quickly, cheaply, and safely. It has opened up areas of the world which were inaccessible.

The airplane saves lives. It is a weapon against pestilence and disease. On one occasion airplanes sprayed enough poison on two and a half million acres in the West to kill 75,000 tons of grasshoppers. The airplane carries the medicine to the patient in time or the patient to the hospital in time. It gets food and fuel to people who are stranded. It certainly has earned its reputation as a humane instrument. Even those whom progress has frightened would be reluctant to give up the gains resulting from the development of the airplane.

In recognition of his distinguished service to the national defense, the American Ordnance Association presented its Levin H. Campbell Gold Medal to General Nathan Farragut Twining at its Thirty-sixth Annual Industrial Preparedness Dinner Meeting. The award carried the following citation:

"Since his graduation from the United States Military Academy in 1919, General Twining has exerted a broad and effective influence on the development of air power as an element of the national defense of the United States.

"In the Pacific, in Italy, in Alaska, and at other posts of great responsibility, General Twining directed the utilization of American air armament to its maximum extent for victory in war. As director of the Air Matériel Command, he further coördinated the scientific and industrial aspects of air armament with engineering and production facilities of the United States for the maintenance of peace.

"The American Ordnance Association confers upon General Twining with expressions of appreciation its Gold Medal named in honor of Lieut. Gen. Levin H. Campbell, Chief of Ordnance, United States Army, 1942-1946, and president of the Association, 1953-1955."

However, these peaceful gifts are insignificant compared with the gift of peace that air power promises.

Superior airplanes and superior nuclear weapons can prevent a war. This was obvious when we held a monopoly in nuclear weapons and a near monopoly in long-range bombers, but it is equally true now.

There are those who argue that Russian development of atomic weapons and jet bombers cancels our war-preventing power. They are wrong. The possible destruction of sources of Red power must be as unattractive to the Red rulers now as it ever was. As long as we keep this capability, the Red rulers still face the same dire penalty.

Many persons misinterpret the effect of Red air-atomic power on United States policy. True, if we were an aggressor nation, their new power would deter us from starting a war. The point is, we never have and we never will need deterring. Our love of peace has not stemmed from increased Red power. Peace is all we ever wanted.

What then is the effect of Communist air-atomic power upon our thinking? Do we value our freedom any less because of it? If our freedom was worth fighting for at the cost of thousands of soldiers, is it no longer worth fighting for because the possible cost is greater?

Here, I believe is the key to the problems and tensions we face. Only by being willing to pay the higher cost of freedom can we keep our freedom. Only if the Communists are convinced that we are ready and able to pay the price of freedom will they withhold an attack. Only if we give them reason to believe that the freedom which was fought for at Valley Forge, at Verdun, at Tarawa, and at Taegu is no longer worth the cost of battle—only then will they feel free to attack.

It has always been true that the more willing we are to die for our freedom, the better chance we have of living. This is especially true in this air age. But mere affirmation of principles like these are of little value unless backed up by capability to keep our promises. This capability we have, and it is growing more powerful daily.

THROUGH the years we have fought a long battle for adequate air power. It is a battle that is never won; that is to say, we will never be able to afford complacency. Nevertheless, we are no longer in a position of weakness. Today we have 119 wings, and should reach our goal of 137 wings by mid-1957. All our wings are now modern, and all our fighters are jets. We are already replacing old jets with new ones.

In aircraft performance we have come a long way in ten years. Effective altitude of first-line fighters has been increased from 35,000 feet to over 50,000 feet. Speeds of production airplanes have been increased from 400 to over 700 miles an hour. As you know, Major Yeager, in an experimental aircraft, has already gone over 1,600 miles an hour,

which is 2½ times the speed of sound.

Power of engines has increased tremendously. In World War II we were proud of a 2,000-horsepower engine. Today thrust equaling 12,000 horsepower is commonplace. Our workhorse bomber of World War II, the B-17, could carry five tons of bombs. The B-36 can carry over forty tons of bombs.

Today's airplanes take longer to build—up to four times as many man-hours. Of course, all this is costing us more. In 1944 a P-47 cost us less than $100,000. Today's F-84F costs three-quarters of a million dollars.

HOWEVER, we are getting more punch for our money today. Our long-range offensive punch is contained in our Strategic Air Command. Two months ago, the last combat B-29 glided into history, and now our main long-range bombers are the jet B-47's and the 10-engined B-36's. B-52's are now rolling off the production lines and will gradually replace the B-36.

The heavy B-52 looks as if it will be as dependable as the B-47 medium bomber. In this, we are very fortunate. In spite of its advanced design, its maze of electronic gear, and the wide range of operational requirements, the B-47 is one of the best airplanes ever made. We used to think the B-17 was a dependable airplane, but the B-47 has proved to be a really trouble-free workhorse. That airplane runs as if it will never quit.

More advanced bombers are now in design. The bomber of the future may be nuclear-powered. When the atomic aircraft engine is finally produced, we will have all the advantages that unlimited range and power will give us.

When most people think of atomic warfare, they think of the Strategic Air Command. Our Tactical Air Command also has a tremendous atomic capability. All the fighters and light bombers in TAC will be able to carry either TNT or atomic bombs depending on what is needed to do the job. Today the main distinction between the capabilities of the Strategic Air Command and the Tactical Air Command is range of operation.

Our offensive power is strong, but the Soviets are strengthening their offense, too. They have a growing stockpile of nuclear weapons and are producing long-range jet bombers. For this reason we are placing ever-increasing emphasis on air defense.

Recently, all the air defense of the Nation was put into a single command—the Continental Air Defense Command. This was a great step toward a really effective air defense. We are continuing to enlarge our radar warning system, and we are continuing to build more interceptor bases. Our interceptors are ready twenty-four hours a day to intercept and destroy any enemy. Their airplanes are equipped with hard-hitting rockets and in the future will be armed with deadly air-to-air missiles.

Our future striking power will be further strengthened by the introduction of pilotless aircraft into our air forces.

We are putting a high priority on the development of the intercontinental missile, and work is progressing. Obviously, we cannot afford to fall behind in this field. This missile will add much to our long-range power.

The F-84F can carry a varied assortment of 5-inch rockets, 1,000 pound bombs, napalm, fuel, and smoke tanks, and four caliber .50 machine guns (Air Force photo).

To add to the mobility and flexibility of our flying units, we are planning new supply techniques. It is ridiculous that a modern fighting force should be tied down by mountainous stockpiles and miles of red tape. No longer can we afford the wasteful operations involved in moving critical equipment slowly through choked pipelines. Future supply activities will be characterized by quick electronic requisitioning and fast delivery of critical items by air.

All in all, the picture looks good. I am optimistic about our present program, but I do not want to imply that I am satisfied. We cannot afford to be satisfied, but we can be proud of the distance we have come in four years.

However, we cannot stand still—we must look ahead. There will be many problems that we must solve if we are to keep the Air Force and the air industry where they should be.

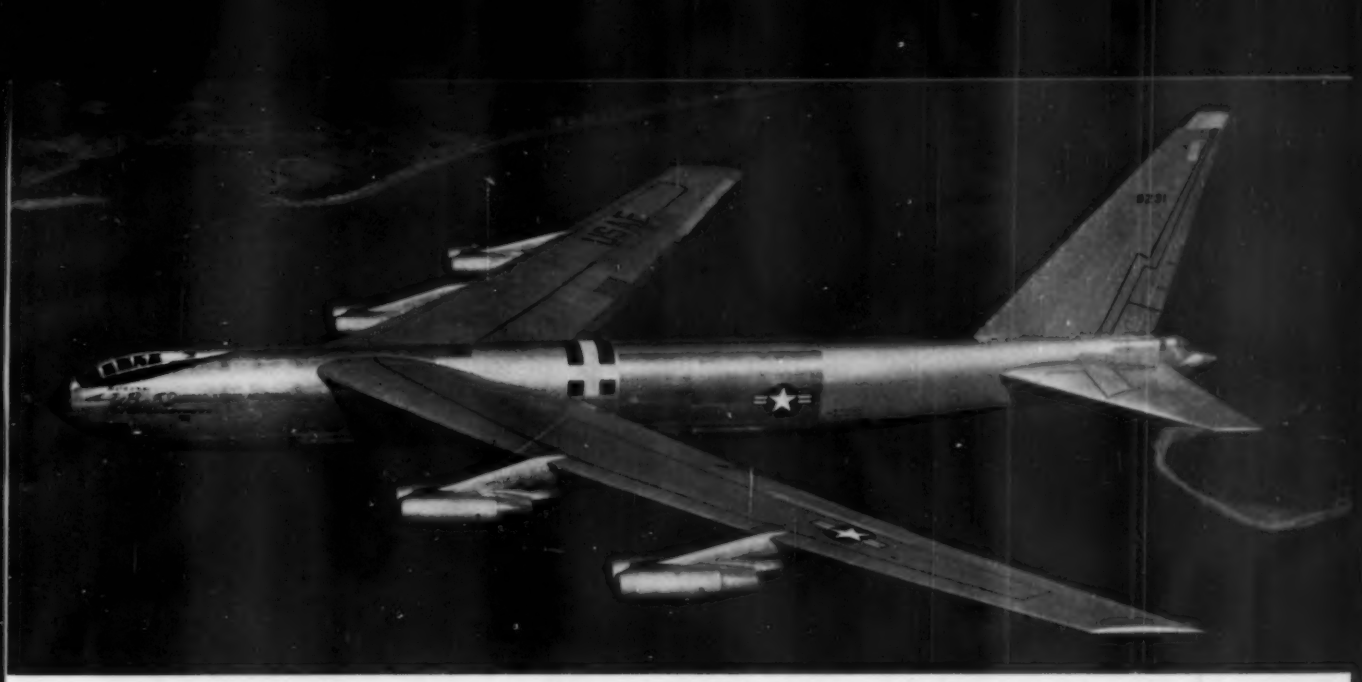
The main problems that the air industry and the Air Force share are technical problems.

Our main task is to stay ahead of any potential enemy. Even though we are considered to be a wealthy nation, we do not have unlimited resources. Whatever we produce is produced at the cost of something else, so we must weigh one weapon against another and choose the more effective.

We have a constant struggle in deciding how many of today's weapons we must buy for the ready defense we need now, and yet be able to afford the weapons of tomorrow. We always must work toward two conflicting goals: to keep our force modern and to develop new weapons that will make the present equipment obsolete.

There really is no choice between obsolescent or modern weapons. Because the Soviets are progressing rapidly, we cannot afford to be without the new and better weapons that science and industry can give us. We cannot afford to sacrifice the lead we now have over the Soviets.

Of course, every technological breakthrough brings a fresh set of troubles. A few years ago the sound barrier seemed difficult to penetrate. Today, with jet and rocket engines, we have



The new 8-jet B-52 intercontinental bomber is replacing the B-36 as the backbone of the Strategic Air Command.

erased the sound-barrier obstacle only to be confronted by the thermal barrier. This one looks more difficult to crack. It really is not a barrier that can be left behind like the sound barrier. The faster we go the more heat we run into.

High-speed air friction raises the temperature of materials tremendously. For instance, at sea-level speeds of less than 1,000 miles an hour aluminum gets so hot that it loses its strength. At that speed, our plexiglass canopies have softened and lost their shape. To lick this problem we must find new materials or new ways of using old materials.

ELECTRONICS are also giving us a lot of trouble. At the speeds and altitudes we operate today, human reactions are no longer enough to do the job. We must depend on electronic bomb sights and gun sights, fire-control systems, radar and radio sets, electronic engine controls, and so on.

One dead tube can have the same effect on the combat effectiveness of an airplane as a dead pilot at the controls. A multimillion dollar bomber can fly half way around the world, but if one electronic part fails when over the target, all the thousands of man-hours, millions of dollars, and training and effort have been for nothing. More important, American lives may have been lost for nothing.

Transistors will help solve our electronics problem, but truly the vacuum tube or the transistor is today's counterpart of the famous horseshoe nail.

These are just a few of the many problems which we must solve if we are to keep ahead, as we must. Some of the greatest gains in our effort to keep ahead come from completely new and unforeseen developments. These developments are often the result of basic research.

Basic research, which is truly the medium by which new horizons are unveiled, is characterized by success only after many failures. It does not show the immediate returns usually expected of Government agencies by Congress and the public. This is one of the reasons that military research is mostly of the applied type rather than the more abstract and probing basic type.

Scientific groups and societies of industries, such as the American Ordnance Association, can contribute immeasurably to the Nation's security by sponsoring basic research.

"Through the years we have fought a long battle for adequate air power. It is a battle that is never won; that is to say, we will never be able to afford complacency. Nevertheless, we are no longer in a position of weakness. Today we have 119 wings, and should reach our goal of 137 wings by mid-1957. All our wings are now modern, and all our fighters are jets. We are already replacing old jets with new ones. In aircraft performance we have come a long way in ten years. Effective altitude of first-line fighters has been increased . . . to over 50,000 feet."

IT may be some time before we have solved all our problems. Yet I have no doubt that on a similar occasion fifty years hence, 1954's problems will seem to have been easily solved, and the problems of the twenty-first century will seem insurmountable. I hope that those men of the future can look upon the past with as much pride as we can today.

A few months ago I read a newspaper account of Russian annoyance at our celebration of the Wright brothers' first flight. They claimed that a Russian inventor had flown an airplane twenty years before. All I can say is that if they ever were ahead of us by twenty years, or twenty minutes, they lost out somewhere along the line! I dare say the B-52 annoys them far more than the Wright brothers' achievement.

We are ahead now, and our task is to stay there. This remains our best chance for peace.

Ready Reserves

It is a cold, hard, military fact that somehow we must find a way to have trained citizen-defenders in a far higher state of readiness for mobilization than ever before in our history

Maj. George Fielding Eliot

TIME and again throughout our history the need for a pretrained citizen defense force has been urged on a reluctant people—on the first occasion, by President Washington. From Washington's time to the present, nothing effective has been done to meet this need, despite the fact that in every war we have fought we have paid a price in blood and treasure, as well as in unnecessary protraction of the period of hostilities, for our refusal to require our young men to give a small portion of their lives to military training.

The American people have preferred to gamble either that they would never have to fight another war or that if they did they could muddle through somehow without irreparable disaster as they have always done.

The years passed. Wars came and went. The speed with which foreign attack could come upon us increased—first as steamers replaced sailing ships, then as man's conquest of the air altered all military calculations. We faced enemies in the Pacific as well as the Atlantic. The European balance of power, on which we had counted to reduce any threat to the Western hemisphere to marginal proportions, was destroyed first by Hitler's Germany and yet again by the preponderance of Soviet force.

Grudgingly, after World War II, we went part way to meet this latter threat by keeping the Selective Service law in operation, drafting part of our young manpower to meet limited requirements, while permitting others to escape through a variety of loopholes.

Major Eliot is military and naval correspondent with General Features Syndicate and military analyst for the Mutual Broadcasting System. He is the author of several books and a frequent contributor to ORDNANCE.

The principle of universal service based on equality of sacrifice without distinction and without escape hatches has been shunted aside by Congress after Congress. Yet it has become increasingly clear that we cannot maintain in peacetime enough full-time defenders to meet the first shock of world conflict nor can we ever again dare to depend on citizen-defenders who are not reasonably trained beforehand.

President Eisenhower has repeatedly gone on record to the effect that he intends to get something done about this in the coming session of Congress—that legislation to provide this country, for the first time in its history, with a real and effective ready Reserve force will be a number-one item on his legislative program for 1955.

Secretary of Defense Wilson, describing the existing Reserve situation as a "mess" and a "scandal," has said that he will have a program ready for Congressional consideration in January and hopes to get "something on the books" in the way of legislation by April 1st.

Indeed that's a "must" of the first magnitude, since the operation of Selective Service under present law comes to an end on June 30, 1955. If there is no replacement legislation enacted by that time, not only will we be without a ready Reserve but without much of an Army of any kind.

In the President's view, the new law must distribute the burden so that all who are physically able will share in it, not leave veterans carrying most of the load as at present. The law as it stands establishes a total "service liability" of eight years for everybody who is inducted or enlisted into the armed forces: thus the 2-year draftee has a 6-year Reserve liability remaining after discharge from active service, the 4-year enlistee has 4 years left to do in the Reserve.

BUT no means exists to compel these men to join a "drilling unit" of the Army or Air National Guard, or of the Army, Air Force, Marine Corps, or Naval Reserve. So they just remain names in a card file unless they join up with a Reserve unit voluntarily. Despite a fairly active selling campaign, only about one per cent of the discharged draftees have done so.

But—and this is very big "but"—a man who is deferred from the draft for educational or vocational reasons, or who just isn't called because his particular draft board has a low quota, neither does any active service nor does he acquire any Reserve liability.

So there are about 1,600,000 physically fit young men in the country who have never served and who have acquired no Reserve liability either.

Should another emergency hit us tomorrow, we would still have a card-file Reserve composed chiefly of veterans—a very large number of Korean veterans and quite a few with World War II service as well.

Call them up again and there'd be blood on the moon. It was bad enough when we had to call World War II veterans for Korean service, redisturbing their jobs, marriages, homes, and prospects while youngsters who had never served plunged ahead and scooped up the economic gravy.

The ideal plan would be something like that suggested by the President's National Security Training Commission—to make every young man register and undergo physical examination at age 18, followed by induction (at 18½ or 19) either for 2 years' Regular service followed by 6 years in the stand-by Reserve; or for 6 months of basic training followed by 3½ or 4½ years in a drilling unit of the National Guard or some other Reserve component, filling out the balance of 8 years' total service in the stand-by Reserve.

IN theory the "drilling" or ready Reserve units could be called to active duty by the President, while the stand-by Reserve could be called up only in an emergency declared by Congress. Under the ideal system, every young man, save the complete physical, mental, or moral misfit, would have to get into uniform and do *something*. There would be no free riders, and those who have gotten by so far would be gradually picked up and processed, too.

But that's the ideal. Unhappily, there seems to be no basic agreement, either inside the Pentagon or among the existing Reserve components or in Congress as to just how this is to be accomplished. The details are of vital importance. For example, who is going to pick the young men who go into Regular service for 2 years and those who take basic training and then go back home, drilling once a week and going to camp every summer for 4 or 5 years but otherwise free to take a job, get married, and start building a future?

National Security Training Commission says let 'em draw straws. Other opinion considers that the local draft board should do the picking, and there are variants of both schemes.

The National Guard, which has most of the Army and Air Reserve units in being which amount to anything in the way of readiness for service, is gravely disturbed because of reports that the manpower experts in the Department of Defense (not so much in the Army and Air Force themselves) want to do away with all State control of the National Guard and make it into a big all-Federal-controlled nationwide Reserve. This would leave the States free to organize merely a few State Guard units for local defense composed of eager middle-agers, voluntarily enlisted.

The Guard is grimly determined to hang onto its dual Federal-State status and its association with States and communities on which all its traditions are founded. It wants its share of the draftees required to join "the National Guard of the several States" not just a Federalized National Guard divorced from all State control.

There is some reason to believe that Secretary Wilson and his immediate advisers do not fully understand the force of this sentiment, nor the enormous military value of tradition and local pride. Also, perhaps they haven't read the record and realized the very real political power which the National Guard can bring to bear. The National Guard Association has already smelled this rat and is up in arms about it.

The Reserve Officers' Association—also powerful politically—is worried lest the National Guard, either Federalized or "as is"—will have the lion's share of the combat units in any new Reserve setup, relegating the existing Army and Air Force Reserves to a secondary place, supplying supporting units, fillers, and replacements.

The R.O.A. has had an able committee at work drafting a Reserve plan of its own—so has the N.G.A. At present writing there is some indication that the two groups are going to get together in an attempt to iron out their differences and come to Congress hand in hand with one agreed plan satisfactory to both of them.

THIS may have jelled by the time these words are in print. If so, it will be a most promising development, for a primary cause of the failure of past Congresses to enact workable Reserve legislation has been the confusion of counsel which the relevant committees have received from these two organizations and from individual "experts" sticking in their two cents' worth.

There are civilian manpower experts in the picture, too. Some of these maintain that there won't be enough manpower to go around—that for the next few years, anyway, due to the low birth rate of the depression years, the Pentagon's figures of 3,000,000 in the active forces and 3,000,000 in the ready Reserves don't make sense.

Defense manpower experts disagree, saying the men are there, especially after picking up the present 1,600,000 free riders.

Industry and organized labor both exhibit some nervousness about the whole program. Both seem to fear that the military will have too much of a hold on the whole of the country's productive manpower.

Educators also are asking whether a narrow view of military needs will get the call over education of scientists and engineers, in which the Soviet Union has lately been reported as forging ahead of the United States.

As though all these divergencies of approach were not enough to confuse the issue, there are very strong differences between the three armed services as to the kind of Reserve forces they need and as to their respective need for drafted men.

The Navy is apparently quite satis-

"It has become increasingly clear that we cannot maintain in peacetime enough full-time defenders to meet the first shock of world conflict nor can we ever again dare to depend on citizen-defenders who are not reasonably trained beforehand."

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fied with the situation as it now exists. What the Navy wants is 4-year volunteers for Regular service; it is not at all interested in 2-year draftees.

The Air Force doesn't want draftees in its Regular enlisted force either. Like the Navy, it claims that two years is just not enough time to train its enlisted men. But the Air Force has a much more acute "instant readiness" problem than the Navy—especially as to those units of the Air National Guard and Air Reserve assigned to the Continental Defense Command.

THE Air Force solution, as of now, appears to be to accept 2-year men (either by allowing 2-year voluntary enlistments or by some process of picking over the draft quotas and choosing those with the highest IQ's); then after two years the man either could be passed on to a Reserve component for two, three, or four years of Reserve duty or he could be continued on active service if needed.

The Army objects bitterly to any "picking and choosing" by the other services. The Army would like to have each service accept a fair proportionate share of each annual or semiannual crop of draftees—proportionate not only in numbers but in mental and physical classifications as well. The Army is sick and tired of having the Air Force and the Navy (including the Marines) skimming the cream off the top of the personnel pot.

The Army's Reserve problems, however, are of a different order from those of the other services. The Army wants National Guard divisions and combat-support units incorporated in corps and field armies with Regular divisions.

IT is hoped that by providing the Guard units with a steady annual flow of pretrained recruits it may be possible to maintain unit training at a level which will allow a state of readiness of the order of M-day plus thirty.

This would permit corps and armies to be moved overseas in an emergency, just about as fast as shipping and port facilities could be made ready, moving out the Regular units first and following with the Guard units.

But the Army also needs Reservists as fillers for Regular units, enabling these to be maintained in peacetime (when in the continental United States) at a lower level of strength than the full war establishment. Fully trained Reservists are to be given "mobilization assignments" to Regular units for this purpose.

It is by this means, apparently, that the number of Regular divisions is to be increased to twenty-four, despite some reduction in the over-all personnel strength of the Regular Army.

Finally, the Army requires National Guard antiaircraft battalions for the Continental Defense Command to be maintained in an M-hour plus twenty minutes' condition of readiness. For this purpose, a nucleus of technical personnel will be assigned to each battery site. These men will be paid as civilians, but will have dual status as National Guardsmen. The rest of the battery personnel will be on the usual National Guard status.

National Guard officers who have given careful study to these problems for many years believe that the bulk of the National Guard's requirements can be met by channeling draftees into the Guard after a period of basic training.

While some Regular Army opinion inclined to the idea that the best way to do the job was to draft everybody for two years and then transfer the men to National Guard units for another two or three years, the Army's personnel ceiling just won't allow this many recruits to be processed each year and still maintain the "hard core" of Regulars that is needed to do the processing and to maintain overseas commitments plus the nucleus of a strategic striking force at home.

The net result seems likely to be a compromise in which, as already remarked, some young men will do two years in the Regulars and thereafter be free of military obligations save in a "Congressional" emergency, while others will do only basic training and then have a longer period of military obligation under conditions which will assure their being called up first if the whistle starts blowing. This seems to be reasonably fair all around, especially as the plan will be designed to eliminate free riders altogether.

The greater the unanimity of acceptance within the military establishment itself, including both Regular and Reserve components, the better chance any ready-Reserve proposal will have of Congressional approval without too much mutilation. The cold, hard, military fact remains that somehow we must find a way to have trained citizen defenders in a far higher state of readiness for a sudden call to arms than ever before in the history of the United States.

YET the cold, hard, political fact must also be faced that this will not be the most popular proposal ever put before Congress, that it affects the lives and the future of millions of young Americans, that in effect it means that hereafter the shadow of military obligation (perhaps on an hour's notice) will hang like a sword of Damocles above millions of youthful heads which are now untroubled by any such disturbing anxiety.

It means an alert and ready America from now on—but the cost must be paid in terms which American citizens have hitherto been unwilling to meet, or have met only grudgingly and partially and with one eye on that rosy future when "the present emergency" is over and America can go back as usual to her peaceful, normal, easy-going ways.

IT isn't going to be easy to induce either our people or their representatives in Congress to accept the fact that the new normalcy is a day-by-day, year-in-and-year-out state of that eternal vigilance which is the price of liberty. But that's the way it is, and the fact should be accepted.

The military establishment will have failed in its collective duty to the Nation if, at this crucial hour, it does not iron out all internal differences and appear before Congress to ask with a single voice for legislation that will give us what we have never had before, that truly ready Reserve on which our safety and indeed our survival as a free people may well depend.

New Tank Buster

The BAT – battalion antitank rifle system – consisting of a 106-mm. recoilless rifle and a caliber .50 spotting rifle mounted on a jeep, can defeat the heaviest types of armored vehicles

Dr. L. B. Hedge

ON October 12, 1954, the latest addition to the family of American recoilless rifles, the 106-mm. rifle M40, was unveiled before a group of members and guests of the Cleveland Post of the American Ordnance Association.

This first showing of the new BAT (battalion antitank) rifle was the highlight of the demonstration and marked the successful conclusion of another phase of Ordnance progress in providing our troops with effective armament.

Maj. Gen. G. M. Barnes, writing in the September-October 1945 issue of this journal, said: "Outstanding as a development, placing weapons of unprecedented striking power in the hands of the individual soldier, the recoilless-rifle project is also a brilliant example of the effectiveness of the Industry-Ordnance Team and of the internal coöperation among various Ordnance groups in carrying to a successful conclusion an accelerated program of theoretical research and mechanical applications."

THESE words are as true a characterization of the BAT development as they were of the program which, almost ten years ago, provided our troops with the 57-mm. and 75-mm. recoilless rifle in the closing months of World War II.

The new BAT rifle system consists of the 106-mm. rifle M40, the 106-mm. rifle mount M79, the M8 caliber .50 spotting rifle, direct- and indirect-fire telescopes and mounts, a matched family of complete rounds of 106-mm. ammunition, and a spotter-tracer round for the spotting rifle. This last item closely matches the trajectories of the major-caliber rounds over that portion of the range most frequently used in antitank combat.

Dr. Hedge commanded a special mission which placed the first U.S. recoilless rifles in combat use in World War II. He is now chief of the Recoilless Weapons Section of the Small Arms Branch, Research and Development Division, Office, Chief of Ordnance, Washington, D.C.

The rifle system is adapted to mounting on the M38A1 ¼-ton truck (jeep) —its normal carrier—and can be fired from the jeep or from the ground. The complete system, not loaded, weighs somewhat less than 500 pounds.

It can be removed from and returned to the jeep by a 3-man crew which can transport it intact by hand over short distances and can move it over more substantial distances and over more difficult terrain by disassembling the rifle proper from its mount. This disassembly and later reassembly are effected by a quick-disconnect arrangement and are accomplished in a matter of seconds.

The BAT rifle is the logical descendent of the 57-mm. rifle M18, the 75-mm. rifle M20, and the 105-mm. rifle M27. A few words on the background of this family of rifles will clarify the discussion of its newest member.

The four recoilless rifles now standard in our Army have been developments in the truest sense of the word. The principles of operation and the details of design of each have been "laid open by degrees."

THE fundamental character of recoil, and hence the basis for its elimination in a firearm, was known to Newton; *i.e.*, to every action there is an equal and opposite reaction. In a firearm the *action* is the ejecting of the bullet or projectile; in a conventional rifle or gun the *reaction* is recoil.

Comdr. Cleland Davis designed several guns in the World War I period which were recoilless by virtue of discharging various types of projectiles to the rear, developing a *reaction* similar in kind to the basic *action* of the forward-moving shell.

Cooke, in 1921, patented a weapon, the logical forebearer of our own recoilless rifles, in which the reaction was developed by a jet of gas vented rearward from the powder chamber.

An extensive patent literature records a variety of contributions to the field of nonrecoiling firearms in the Davis and Cooke traditions—details for and accessories to basic weapons of great size and weight. Technologically these developments were sound, but they were useless, or nearly so, as weapons of war.

During World War II, development of recoilless artillery (as opposed to recoilless rifles) was undertaken in this country, by our allies, and by our ene-

mies. Several German and at least one Russian development in this line preceded our own, and usable recoilless cannons and mortars were produced both here and abroad.

None of these weapons has retained status as a standard item in any country, although many were technically successful.

Development of recoilless rifles was initiated in this country in June 1943 by the small-arms development group headed by Col. R. R. Studler, now retired, in the Ordnance Department of the Army. The program was originally conceived to provide an infantry weapon or family of weapons which would combine the accuracy of the small-bore rifle and some of its range and portability with the antitank lethality already provided at close ranges by the "bazooka" with its hollow-charge rocket ammunition.

UTILIZING the gas-jet reaction system employed by Cooke, recoilless rifles were conceived and executed in the best tradition of small-arms design, a tradition which holds lightness of weight, smallness of size, and convenience of use as necessities rather than luxuries.

Such recoilless rifles in 57-mm. and 75-mm. caliber, with hollow-charge antitank projectiles and other types of ammunition for each, were placed in the hands of combat troops before April 1945.

In June of that year, a scant two years after the initiation of the program, these rifles with their ammunition and accessories were standard infantry weapons in our Army.

Although they were intended primarily for ground firing and hand carry, both these rifles have been used successfully on vehicles. Ordnancemen (including the author) working with men from the 82nd Airborne Division improvised and used jeep-mounted 75-mm. rifles in operations in the Cologne area in early 1945.

An adaptation of the 75-mm. rifle to the M32 tank retriever was devised in Korea and used in our combat operations there. These and other field expedients, devised to place both 57-mm. and 75-mm. rifles on anything that would carry them, have been popular wherever fighting men have had recoilless rifles. They reflect the desire, evident wherever these weapons were used, to have one handy on any fighting job that came along.

The T19 105-mm. rifle had been carried through engineering tests by the end of World War II. In the period which followed V-J Day, work in the recoilless-rifle field was largely concentrated on refinement of the still rather crude interior ballistic theory of these weapons, and on basic design problems which had been by-passed with empirical solutions during the highly accelerated wartime program.

When the Korean crisis made evident the acute requirement for a heavier duty recoilless rifle, the T19 105-mm. rifle was standardized as the M27 and placed in production to meet this need.

COMBAT and training experience with the M27 and the continuing postwar study and design program provided the basis for establishment, in early 1950, of a project for development of a battalion antitank rifle system.

The project aimed at developing a recoilless rifle with ammunition and accessories to consolidate the latest advances in the art and to provide the best practicable combination in this order of importance: maximum destructive capacity, maximum range with high first-round-hit probability, minimum weight, and maximum rate of fire.

At the inception of the BAT program, recoilless-rifle development was still continuing, under the active direction of the small-arms development group of Ordnance Research and Development, in the basic tradition of Industry-Ordnance coöperation under which it had made such spectacular early strides.

The Frigidaire Division of General Motors Corporation, the first nongovernment facility to enter this field, was still carrying a major part of the development. The National Forge and Ordnance Company was active in design and experimental model work. Armour Research Foundation and the Midwest Research Institute were making basic contributions to the ballistic, metallurgical, and mechanical phases of recoilless-rifle design.

FRANKFORD Arsenal continued as the primary Ordnance arsenal in this field, and Dr. W. J. Kroeger and C. W. Musser of Frankford, holders of the basic U. S. patents on recoilless rifles, continued in active leadership of the emerging science and art of recoilless weapons.

The gunner uses the .50 caliber spotting rifle to bring the BAT on target during recent tests of the new 106-mm. recoilless rifle at Aberdeen Proving Ground, Md.

With barrel lowered into traveling position, the M40 can be transported quickly over rough terrain (Army photo).

The BAT program set a large and difficult task for this team. The first necessary step in initiating the active development was an expansion of the recoilless-rifle facilities. Activities at Watervliet and Watertown Arsenals and at Springfield Armory were early dedicated to contributions to the BAT development. Contracts with the Firestone Tire & Rubber Company, Parish Pressed Steel Company, Remington Arms Company, and Winchester Repeating Arms Company were integrated with increased contract activities at Frigidaire, Armour, and Midwest. This was done to provide a broad and effective development front adequate to the effective exploration of several variants of the basic recoilless system with a minimum of duplication of effort.

AMMUNITION development for this new system was planned and supervised by the Ammunition Branch of Ordnance Research and Development, with active development work established at Picatinny and Frankford Arsenals and by contract with Firestone and the Chamberlain Corporation.

As the program progressed, the development group working on rifle and ammunition was extended to include Rock Island Arsenal, Aberdeen Proving Ground, Erie Ordnance Depot, Harvey Machine Company, American Machine & Foundry Company, and others.

LONG before the inception of the BAT system development program, it was well recognized that range determination was one of the major problems of antitank armament effectiveness. A tank is a moving target which must often be engaged over unfamiliar and unsurveyed terrain. Under such circumstances a high probability of first-round hit is dependent, with the most accurate weapon, upon a precise determination of the weapon-to-target range.

Early in the discussions preliminary to establishment of the BAT requirements, an Army Field Forces representative reported that infantrymen in Korea had used carbines and M1 rifles as range finders with modest success. They transferred the range read from the sight of the small-bore weapon after an observed hit on the target to the sight of a recoilless rifle or other antitank weapon.

Following a discussion of this procedure it was decided to include in the BAT system development program an exploration of the possibilities of matching the trajectories of small-caliber spotter-tracer rounds to the trajectories of the major-caliber BAT rounds and of using a semiautomatic spotting rifle firing these spotter-tracer rounds as a ranging device for the system.

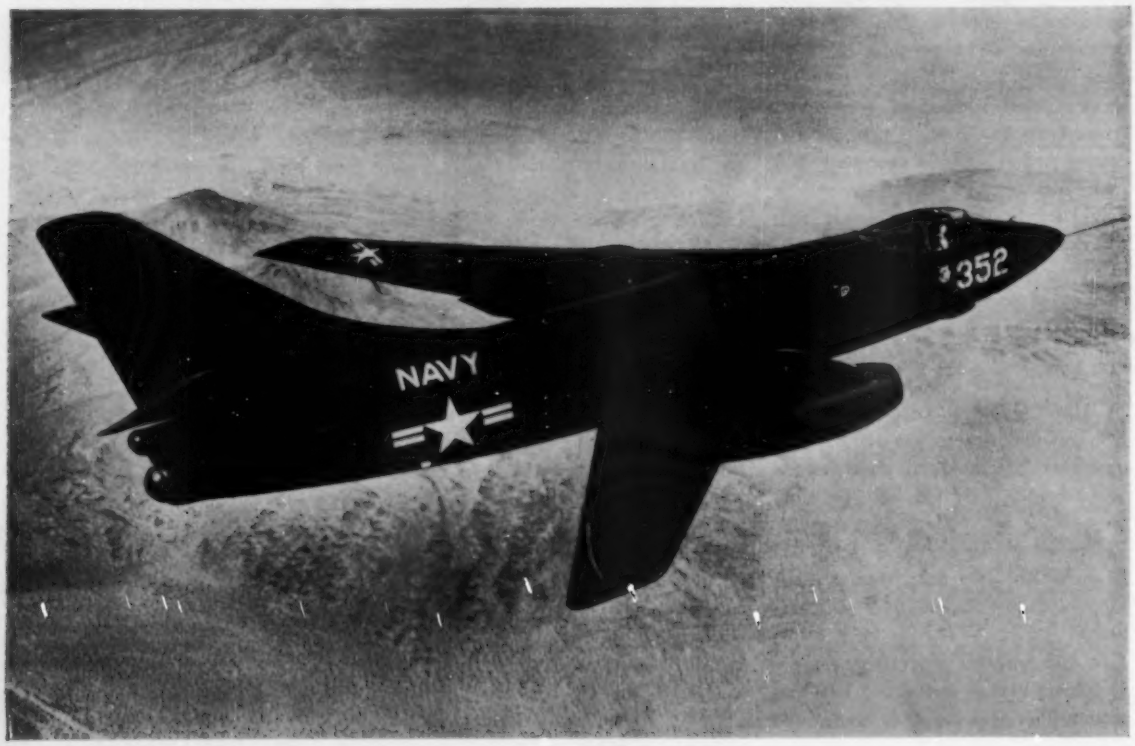
The problems of trajectory matching, round-to-round uniformity, and semiautomatic rifle design have proved far from simple, and the present solution, although highly practicable, is far from ideal. Nevertheless the development at Frankford Arsenal, Springfield Armory, Winchester, and Remington has culminated in a ranging system which provides probabilities of first-round hit unattainable with any other known system of comparable simplicity and ruggedness.

BEYOND the spotting rifle ranging system discussed above, the new BAT system embodies a host of refinements in detail and concept which make it a vastly more effective weapon than its forebearer—the M27.

The new rifle has made full use of advances in ballistic theory and metallurgical and design techniques, and it is provided with a family of rounds of ammunition which are likewise the last words in their respective types.

Recent Naval Aircraft

The Chance Vought F7U-3P photographic version of the Navy's Cutlass, above, carries 5 cameras in its nose and a large number of flares in place of armament. The Douglas A3D Skywarrior, below, is so powerful that when its twin J-57 turbojet engines are supplemented with jato units the attack craft can take off from a carrier without using a catapult.



Mobility—Key to Victory

On the atomic battlefield rapid dispersion, swift concentration, violent execution, and far-flung operations will decide the issue, and modern armor is best suited to fulfill this decisive rôle

Maj. William G. Bell

THE countries of the world find themselves in a strange position today with respect to national defense.

On the one hand, all manner of revolutionary weapons are in various stages of development, their characteristics readily permitting their assignment to the realm of "push-button" warfare, while their performance serves to transfer that classification from the outer space of science fiction to the inner area of scientific fact. On the other hand, war goes forward with conventional weapons.

As we consider just where we stand —what form our national defense is to take on land and in the foreseeable future—what answers do we get?

The considerations bearing on our national-defense thinking, planning, and preparedness, seem to be these:

1. In the alignment of powers, both sides have an atomic capability.

2. The terrifying consequences of atomic weapons and a fear of reprisal may, as with gas, rule out their future use.

3. Peacetime development of weapons and organization must be theoretical to a great extent; they are proved in war.

4. We must develop and refine within the conventional area while being prepared for atomic warfare.

5. We must be prepared for both offense and defense.

The visionaries who foresee an early substitution of our conventional weapons and ground forces by advanced weapons and limited manpower are indulging in wishful thinking. Sound military reasoning supports the continuing requirement for conventional ground forces using the proven tools of war.

Major Bell served in the 28th Cavalry Regiment until its inactivation in early 1944 when he was assigned to the 350th Infantry Regiment for the Italian campaign. Prior to his present assignment in the Staff Secretariat at Allied Forces, Southern Europe, he was editor of Armor *magazine.*

It would seem that we may look for no spectacular shift from familiar weapons and organization—no overnight dissolution of our conventional armies in favor of a magic weapons system, manned by a few technicians, that would wreak disaster upon an opponent at little or no loss to ourselves. Rather, there is in sight a gradual evolution within the conventional pattern, evidenced by such events as the phasing in of the 280-mm. atomic cannon.

But we would be just as much off base to ride along in blind acceptance of orthodox methods as we would be in placing our trust in untried and unproved weapons and organization. What, therefore, might be done in the so-called conventional area to accomplish improvement which in turn might head us in the right direction for the atomic battlefield?

Does not the answer to this question lie in the word "mobility"?

Maj. Gen. J. F. C. Fuller, the eminent British military analyst, in a distinguished piece of writing in Brassey's Annual for 1952, has pointed out that "there have been only two great revolutions which have radically changed the organization of armies. The first followed the adoption of the horse as a military animal, and the second the introduction of the internal-combustion engine as a military machine."

The great significance of these two historical events is simply that each took the soldier off his feet and *mounted* him and his firepower. As General Fuller notes, "the introduction of cavalry led to the birth of tactics—ability to reconnoiter, charge, maneuver, reënforce, and pursue. Arising out of this emerged a new factor, power to surprise, and therefore attack of an enemy morally as well as physically."

DESPITE the significance of mounted mobility to ground forces and despite the fact that we stand on the very threshold of an age of push-button warfare, we have failed to embrace fully the mounted concept in conventional warfare. The horse was introduced into combat some four thousand years ago, while mechanization has operated in history's greatest wars. Yet the mounted concept still begs for general acceptance, and our ground forces are built around the classic dismounted arm.

Instead of refining and perfecting our mounted arm and developing a pure doctrine of mobility, we have spread

our mounting thinly across our dismounted arm in an inbreeding process which has compromised a full and ideal use of mounted potential.

In Armor, our mounted arm, whether we consider the tank battalion or the armored division, we see a support unit that is the subordinate element in a parent infantry formation.

In World War II only one-sixth of our divisions were armored. We never fielded an armored corps in combat. Our standard corps is at best two-to-one infantryheavy and is employed in terms of its infantry elements. Our three Reserve armored divisions not long ago were redesignated infantry. The divisional force we have contributed to the defense of Western Europe is two-thirds infantry.

It appears to be traditional that we consider our ground forces in terms of infantry and specifically in terms of the infantryman—the rifleman, the foot soldier. Frequent pronouncements to the effect that the machine will never replace the man on the battlefield are often set in an infantry context.

There is not a balanced awareness of the "ground soldier" as the man who serves self-propelled artillery pieces, mans tanks and armored cars, and operates the machines of war. It is the ground soldier who will not be replaced. The infantryman may well be, to a certain degree.

WHAT are the American national characteristics favoring the development of a mobile base for our Army?

1. Our American men come to military service with perhaps a higher degree of technical knowledge and native mechanical aptitude than any other nationals in the world.

2. We have a rich store of scientific capability and potential, with a foundation of opportunity to perpetuate and expand it.

3. Our industrial capacity is unsurpassed.

4. We have great wealth.

We are thus enjoined to take full advantage of a combination of valuable assets whose application to the ground battlefield and in terms of the mounted mobile elements is self-evident. Armor is certainly a characteristically American arm.

During World War II, General Eisenhower asked his historian, Col. S. L. A. Marshall, to rate all divisions in the European Theater according to performance. The results of the evaluation by the historical staff indicated that armored divisions had attained a high general standard of performance, whereas there were extreme variations in the ratings of the infantry divisions. Although the reasons for this were not officially deciphered, it is not far fetched to believe that some of the reasons set forth above contributed to the findings.

There can be little doubt that *horizon* has much to do with individual and collective reaction and effectiveness on the battlefield. How does this affect our ground soldiers? Variations in foreground and horizon undoubtedly have marked affect upon individual and crew performance. There appears to be a degree of rapport among the crew of a tank, for example, which plays a more decisive part than in the team operating on foot and in the open.

The foot soldier's horizon is limited. His objective is in the foreground. More often than not it is a hill, a ridge, a mountain—something above him, something which, quite apart from the consideration of enemy opposition and emotional enervation, will require physical effort to reach, and his thinking is conditioned by it.

On the other hand the mounted soldier's view reaches well forward—to and in a sense beyond the visible horizon. Physically he is higher off the ground. His over-all role of mobile operations—of reconnaissance, exploitation, pursuit, connotes distance, movement, advance! His "psychological reach" thus becomes more appreciable than that of his comrade on the ground.

There is certainly a morale factor involved in the case of the mounted soldier that is an item on the positive side. Turning once again to General Fuller and a post-World-War-I comment: "In the next war," wrote the General in 1922, "we may expect tactical organization to proceed . . . at an enormous speed, if muscle be replaced by petrol . . . weapons will become more and more powerful, protection more and more mobile, mobility more and more speedy, and morale, safeguarded by these three, more and more firm."

THE firmness drawn from his "mount" by the mounted soldier may be just such a psychological lift as that experienced by the average citizen in getting behind the wheel of a car, or in mounting a horse for a ride along a favorite trail. Training and discipline translate that added something into a positive factor that works on behalf of the individual and the team.

Unfortunately, it is not possible to broaden this discussion with a comparison of reaction in battle of mounted and dismounted soldiers. The preoccupation has been with the foot soldier, the infantryman, the rifleman; a substantial amount of material exists on the dismounted soldier but not on the mounted soldier.

However, reports have been published noting that "in any given action in World War II, only twelve to twenty-five per cent of all combat soldiers (infantry) who were armed and in a position to fire their weapons at the enemy were able to pull the trigger." The figure is reported by Army psychiatrist Col. Albert J. Glass to have been upped to fifty per cent on the Korean battlefield. A great gap still exists.

Since this matter of soldier reaction in battle is significant in a consideration of the organization of our army and the doctrine of its employment, it is only natural that we ask ourselves a series of questions bearing generally on the mounted-dismounted subject.

What does the tank do for the tanker on the battlefield? Among mounted soldiers, are there as many individual failures to act as there are reported to be among riflemen? Does the tank, with its ability to move, its protection and its armament, its imparted sense of power and crew companionship instill a proportionately higher degree of combativeness in the individual soldier?

The 120-mm. gun tank T43E1 is a potent factor in our armored firepower.

What difference, if any, can be expected between the orthodox foot infantryman and the armored infantryman? What is the difference in reaction between the artilleryman serving an emplaced gun and one serving a self-propelled gun?

The army that comes up with the answers to these questions, and applies the findings, will be a long step ahead.

Since this appraisal relates to a transition of conventional forces that will place them in a position to operate in warfare involving any weapons now known to us, we can hardly escape a projection of our consideration to the atomic battlefield.

President Eisenhower, in his address before the 1953 General Assembly of the United Nations, stated that "atomic weapons have virtually achieved conventional status within our armed services." The President went on to note that "the dread secret and fearful engines of atomic might are not ours alone," following up with a specific reference to the Soviet Union. Thus we must consider a very unpleasant but very real contingency.

IN 1951 the writer had occasion to review editorially for another service magazine the implications of atomic developments with respect to the ground combat picture. Here is an extract:

"The tactical use of atomic weapons will multiply the value of mobility in the combat zone. Mobility will be a primary means of protection, for dispersion will be ever more important should the enemy employ atomic weapons.

"At the same time that mobility is essential for dispersion as a manner of tactical protection, so too will it be essential for the rapid concentration of units at decisive points. Mass employment must still be the basis for decision.

"Armor is ideally suited for rapid dispersion and rapid concentration.

"Armor appears to be the ideal basis from which to perfect the new measures which will be required for survival on the atomic battlefield. It seems logical to assume that proper protection will be forthcoming only when ground personnel in the battle area are mounted in fully mobile armored vehicles whose characteristics include protection from blast, heat, and radiation.

"Only a force mounted in vehicles combining mobility, properly developed atomic protection, and inherent firepower will be able to survive on the atomic battlefield and carry the fight to the enemy . . . armor is such a force."

It hardly seems far-fetched to say that in armor lies the means for relieving the infantry of its high casualty rate. As Lieut. Gen. W. D. Crittenberger has put it, the use of a sizeable amount of armor on the battlefield is a furtherance of that basic American concept to utilize fully our technological supremacy to reduce battlefield casualties. For armor signifies mobile warfare; infantry, position warfare.

In the words of Field Marshal Rommel, "position warfare is always a struggle for the destruction of men, in contrast to mobile warfare where everything turns on the destruction of enemy material."

It is armor that supplies us with mobility on today's battlefield—integrated mounted mobility of all arms. There is a great distinction between being mounted—being able to fight mounted—and being transported. There is much confusion today on the part of many who consider transported elements as being mobile troops. In the full sense—the ability to fight mounted—they are not.

ARMOR advocates often are condemned for their championship of the tank by those who fail to recognize that their statements on behalf of the tank are appeals for a rôle, not a weapon. As Deputy Defense Secretary Anderson said last year, "the weapon is the servant of strategy, not its master." The mounted soldier is well aware of the limitations of his tools and of the need for constant evolution in the field of means to carry out the mobile rôle. He is equally aware of the logistics problems involved and the matter of high gasoline consumption.

Certainly armor had its limitations in Korea. Korea was hardly the common denominator of war. Its denominator was infantry, and such "brush-fire" wars in nonmobile areas of the world can little help being bitter and drawn-out affairs of great loss and small decision. If we want to fight more Koreas and Indo-Chinas then of course we want ground forces that are predominantly infantry.

The capitals of many major countries of the world and many key industrial complexes, such as the Ruhr, lie in areas highly suitable for mobile warfare. And in the world today, while many areas are of great importance, it is Western Europe, a classic mobile

warfare area, that holds attention as the "center of gravity."

On the eastern side of the line that cuts a continent, our master opponent is reported by the New York *Herald Tribune's* Paris edition as having in East Germany some 31 divisions totaling about 400,000 men. What is the reported breakdown? *Eighteen armored, four infantry, and nine artillery or anti-aircraft!* The armor is estimated to include 5,500 tanks, of which some 2,000 are said to be Joseph Stalin III's.

Hand in hand with this Red strength, the training of Communist East Germany's expanding army is being stepped up along the lines of offensive warfare, according to West German reports through the Associated Press. These reports state that the accent in training of officers and officer cadets is on armored attack, in which "tanks, supported by motorized infantry, spearhead attacks against 'enemy' forces."

We've come a long way since June 1950 when, hard on the heels of our high-command statements indicating that the tank and tank warfare were on the way out, North Korean T-34's rolled across the Thirty-eighth Parallel. Today we are better off!

What are the developments and what the hopeful signs?

IN something less than four years we have backed ourselves with a family of tanks. We have an armored combat training area. We have increased our strength from one to three armored divisions. We have joined two of these under a corps headquarters. The National Guard has increased its armored division strength from two to three with another in prospect. Of two divisions to be designated to test atomic battlefield organization, one will be armored.

These are long steps forward when viewed in the light of the situation in effect so recently as mid-1950.

The subject of mobility is not one to be considered only from the standpoint of organization. It involves concept, doctrine, techniques, command, and many other elements—not least the mind. From all these elements will spring the motivation and the action in the evolution of our ground forces.

Whatever tack ground force reorganization takes, it should obviously be in the mobile area. The long train of military history which shows all elements as existing to support the infantry needs redirection. On the modern battlefield it is difficult to look upon the dismounted infantry as other than what historian J. Margolin has called "a collection of laborers using hand tools."

And while there is great potential in the airborne-air-transport fields, we must remember that a paratrooper arrives in a drop zone on his feet—a dismounted infantryman—while an air-landed soldier requires a landing field and favorable weather to put him into action.

Air-transported armor? On many occasions we've seen light tanks roll into and out of C-124's while photographers scurried around taking packs of pictures. But, hang it, we've never seen one fly! Tank too heavy? Plane too big? Perhaps. But the light, light stuff, when we have it both in airplanes and armor, while fine for the cavalry rôle of reconnaissance and screening, will never do all the mobile tasks, some of which are weightier.

Marshal Juin last year remarked: "The enemy has installed himself in Saxony and in the Thuringian salient, 150 kilometers from the Rhine . . . If one transplants to the Rhine region that offensive maneuver developed by the Russians . . . against the Germans in 1944 and grants them the same concentration of forces and rhythm of advance, such an attack . . . would be capable of reaching Paris in twenty-three days."

THE person who would expect the Russians to accomplish that with infantry would be as mistaken as the person who would expect to stop them with infantry—or with a swarm of light-weight, thin-skinned vehicles.

Certainly we need a good proportion of infantry in our Army. But as warfare shifts from trenches and Maginot Lines, from static and continuous fronts, from holding to moving situations, from defensive to offensive action—from stalemate, if you will—it is the mounted, mobile forces that come into play, and it is here that our emphasis should now be placed.

Mobility is the very foundation of offense—and certainly atomic weapons place a premium on offense. On the atomic battlefield the side capable of outranging the other, forcewise, will be the successful one. Rapid dispersion, rapid concentration, violent execution, far-flung movement, ranging operations, offense—these bespeak mobility, the hinge for decision and victory on the modern battlefield.

American tanks helped strengthen our allies abroad (I.N.S. photo).

Airborne Training

Three weeks of intensive training at the Fort Benning Infantry School produce paratroopers geared to meet the demands of atomic warfare and increase the striking power of our forces

Maj. James H. Tate

IN 1784, Benjamin Franklin predicted the rôle of the airborne infantryman in modern warfare when he asked:

"Where is the prince who can afford so to cover his country with troops for its defense, as that ten thousand men, descending from the clouds, might not, in many places, do an infinite deal of mischief before a force could be brought together to repel them?"

The U. S. Infantry has supplied the answer. At the Infantry School, Fort Benning, Ga., the heart of airborne activities, paratroopers today are being geared to meet the demands of atomic warfare. Authorities believe it will be airborne troops that will move in after an atomic attack, catching the enemy while he is still under the shock of the blast.

Last spring the rôle of the airborne infantryman was demonstrated in the atomic phase of Operation Flash Burn, a gigantic Army maneuver at Fort Bragg, N. C. The exhibition of combat expediency, air transportability, and aërial delivery greatly impressed top-ranking officials who witnessed the exercise.

Among the many indications of airborne units' expanding part in our national defense is that newly commissioned Regular Army lieutenants are now required to take either airborne or Ranger training. Officials at Fort Benning say airborne troops have great striking power and that their mere presence ties down many enemy reserves who must be alert for attack from the sky.

Fort Benning and paratroopers have become synonymous, and rightly so since the birth of U. S. airborne training at the Infantry School in the summer of 1940.

However, the airborne story goes as far back as the fifteenth century when Leonardo da Vinci designed the parachute. In the eighteenth century, a Frenchman named Montgolfier launched the first successful balloon. The same century saw the famous European balloonist Blanchard make a parachute jump to save his life. At the time the Wright brothers made their first flight at Kittyhawk, the conception of the parachute was over 600 years old.

Two great advocates of airborne troop utilization, Sir Winston Churchill and the late Maj. Gen. Billy Mitchell, tried unsuccessfully to bring such troops into action during World War I.

In 1928, General Mitchell arranged the first display of airborne might at Kelly Field, Tex. Although the small group of American soldiers who were dropped had assembled their weapons and were ready for action three minutes after they left the airplane, Army officials were not ready to give the green light to experiment with airborne possibilities in earnest.

From this demonstration came Russia's and Germany's leap into paratrooper training. In 1930, Russian paratroopers were dropped in war maneuvers at Veronezh. Six years later it was reported that 5,000 parachutists were dropped at one time during maneuvers at Kiev.

Back home, the vision of flying infantrymen was not completely lost. Maj. Gen. Preston Brown, commander of the Panama Canal Department, moved a battery of the Second Field Artillery ninety miles by air transport in 1931 from France Field across the Isthmus to Rio Hato, Canal Zone.

The following year, Capt. (later Lieut. Gen.) George C. Kenney made another experiment in airborne history by air-landing an infantry detachment behind "enemy" lines during maneuvers at Fort Du Pont, Del. Further advancement was made in 1933 when three batteries and the headquarters of the Second Field Artillery were transported by air from Bejuca to Chorrera, Panama, a distance of thirty-five miles.

BY 1938 the U.S. Army's Command and General Staff School began including airborne warfare in its theoretical tactical instruction.

In Europe, German soldiers had marched into the demilitarized Rhineland and their country had signed the 1936-1937 pact with Italy and Japan. On March 12, 1938, German forces

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Above, students drop from 250-foot training tower, Fort Benning (Army photo).

Above, student dangles in swing landing trainer. Below, jumpers practice from 34-foot mock training tower (Army photos).

were flown to the Aspern Airport in Vienna during the occupation of Austria.

It was necessary, on October 7, 1938, that German occupation troops move into the Silesian town of Freiwaldau for political reasons. To accomplish this, Von Rundstedt utilized 305 Junkers 52's, in which he loaded a complete infantry regiment, approximately 2,800 men, with accompanying weapons. The landing was made on a rough wheat field near Freiwaldau with complete success.

BY World War II, Russia and Germany had trained thousands of parachutists. Russian airborne troops were first used in actual combat in 1939 in the Russo-Finnish War. In 1940, Germany used a large number of paratroopers to spearhead her invasion of Holland and in the assault on Crete the following year.

To transport her airborne troops, Germany utilized the glider which she began developing in 1937. *Luftwaffe* officers and pilots had experimented with this and other types, so Hitler had a number of trained glider pilots at the outbreak of World War II. Gliders, under the direction of Gen. Kurt Student, became an important part of the Third Reich's airborne program.

Germany's method of attack with gliders was to approach the objective in a spiral and land crewmen and infantrymen to clear the area for the paratroopers who would come later. This was the opposite of the American and British procedure which was to drop parachutists first and secure landing zones for gliders which brought in artillery, troop reënforcements, and supplies.

Although the United States and England entered the glider-transport field in 1941 and began training glider pilots, another airborne program was trying its wings at Fort Benning.

THE U.S. air-infantry story really began May 6, 1939, with the Army's suggestion that a small detachment of air infantry be organized. It was decided that a study should be made to determine the kind of equipment and supply required for airborne operations, suitable missions to be performed, degree of control to be exercised by higher command, and collaboration with the Air Corps in obtaining the necessary aircraft.

The Engineer Corps said that since these troops were to be used primarily as saboteurs and demolition crews their training and employment should be under Engineer direction. The Air Corps proposed that they be "marines" of the Air Corps, to be designated Air Grenadiers. The Infantry insisted that airplanes were but a means of transportation and that the primary mission of such airborne troops was to fight on the ground as ground soldiers after they had landed.

The Infantry won its point, and on April 25, 1940, the organization of a test platoon to function under the Infantry Board at Fort Benning was approved.

Following the successful airborne tactics of the Germans in Holland and Belgium, the Fort Benning test platoon under the supervision of the commandant of the Infantry School began recruiting volunteers from the 29th Infantry Regiment.

An 8-week training schedule was mapped out. It included all phases of parachute training from the first orientation flight and the packing of parachutes to jumping from airplanes in flight, calisthenics, hand-to-hand combat, forced marches, and a daily 3-mile run. In addition, there was the regular schedule of standard Infantry training.

In July, Lieut. Col. (later Maj. Gen.) William C. Lee, who is considered the father of the Airborne, recommended that the 48-man test platoon move to Hightstown, N. J., to train for a week on jump towers which he had seen at the New York World's Fair. The training, which gave the sensation of jumping from an airplane, was so successful that two of the 250-foot towers were purchased and brought to Fort Benning. Three such towers are in use there today.

On August 16, 1940, members of the test platoon, wearing football-type

helmets, standard Air Corps escape parachutes, and emergency test-type parachutes, jumped from a Douglas B-18 plane at Lawson Field.

The enlisted members of the platoon drew lots to determine the first to follow the platoon leader, Lieut. (later Col.) William T. Ryder, out of the airplane door. Pvt. William N. King of Nashville, Tenn., became the first U. S. Army enlisted man to make an official jump as a paratrooper.

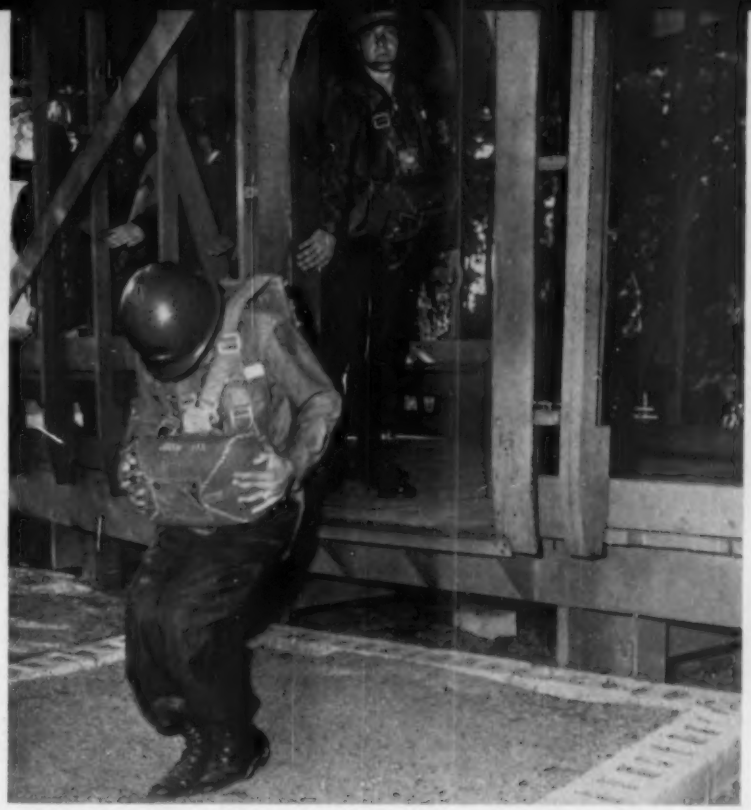
"We were so well trained that we did everything automatically and didn't think about being frightened," said King, now a master sergeant assigned to the Infantry School's Airborne Department. Thirteen days later, the first mass jump in the U.S. was made by the test platoon.

THE first airborne combat unit, the 501st Parachute Battalion, was organized in September 1940, under the command of Maj. (now Maj. Gen.) William M. Miley. In July 1941, the 502nd Parachute Battalion was activated with men of the 501st as cadre.

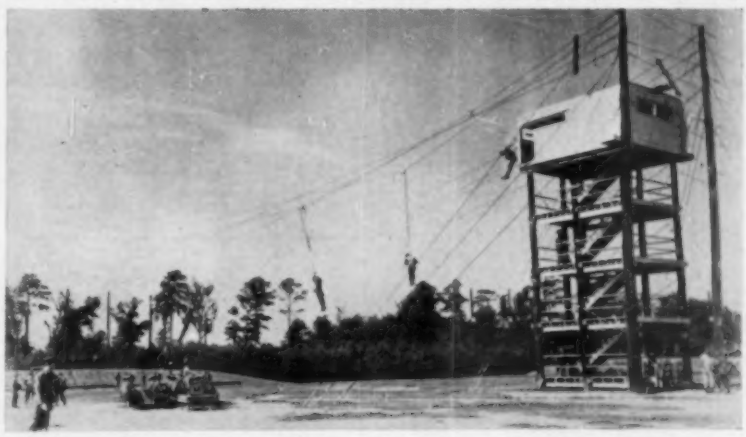
Since the establishment of the Parachute School on May 15, 1942, it has been known as the Airborne School and the Airborne Section of the Infantry School. On May 1, 1949, it became the Airborne Department of the Infantry School, now headed by Col. Leland G. Cagwin of Carbondale, Pa.

Each month during World War II, airborne training produced 4,000 qualified parachutists. Since the inception of the original test platoon, 188,263 paratroopers have been trained at Fort Benning with more than 1,000,000 student jumps being made during that time. Maj. Gen. Joseph H. Harper, Infantry School commandant, and Brig. Gen. Carl F. Fritzsche, assistant commandant, both are qualified paratroopers.

TODAY the airborne course consists of three weeks of training for enlisted men and four weeks for officers and top-grade NCO's. During the first week, the student is instructed in the basic technique of parachuting. After an hour's orientation comes the introduction to parachute training, physical training, mock-up tower training,



Above, airborne students at Fort Benning practice exit technique from mock-up aircraft door. Below, slide from 34-foot tower simulates shock of jump (Army photos).



Below, student receives last minute instructions from jumpmaster before making one of five qualifying jumps necessary for paratrooper wings (Army photo).

mock-up door training, and PLF's (parachute landing falls).

The PLF is a technique which utilizes five points of contact when a paratrooper touches the ground following a jump. The five points are: balls of the feet, the calves, the thighs, the buttocks, and the "pull-up" (Tisimus dorsal) muscles of the shoulder and back. Paratroopers learn to make all their falls on these fleshy portions of the body, in the order named, to reduce landing shock and minimize the chances of receiving a bone fracture.

During physical-training periods the embryo troopers tone up muscles to withstand the shocks and strains they must endure during jumps. A 34-foot tower is used to teach the novice jumper how to attain a good body position during the fleeting moments between exit and opening shock.

The trainee is suspended from a harness as he goes out the door. He falls free for eleven feet, then is brought up sharply as his harness risers are extended to full length, simulating the opening shock of an actual jump.

The trainee descends to the ground along a cable terminating on a gravel mound thirty-five yards from the tower. This apparatus has won a reputation for "separating the men from the boys." More trainees "wash out" of paratroop training in this phase than in any other element of the course.

THE second week of the course is conducted in the 250-foot tower area. There the fledgling trooper, suspended from an inflated parachute, is pulled to the top of one of three towering steel structures which have become Fort Benning landmarks. At the summit the chute is released from its guiding device and the trainee drifts to earth.

The trainees continue suspended-harness, mock-up-door, and mock-up-tower training during the second week. Physical fitness is stressed at all times. Should a man slow down on his job or take an unauthorized rest, he improves his physique by ten push-ups.

Individual "tap-out" jumps and mass parachuting highlights the third and last week of airborne instruction. On the way to the paratroopers' first jump, there is an air of tension and nervous anxiety in the airplane. The troopers sit hunched over by their parachute harnesses. Some of them quietly watch the ground below. Others squirm and laugh at nothing.

Friday of the third week finds the trainees lined up, with collar brass and belt buckles shined and boots polished, to receive their "wings." They have completed five jumps from an airplane and are now qualified for assignment to an airborne unit.

For officers and enlisted men of the top three grades, graduation marks the end of four weeks' training. A week prior to the beginning of the basic parachute course they started their instructions by studying air movements and aërial delivery—with a generous seasoning of physical training.

In the air-movement classes, officers and NCO's study the various types of aircraft in which they may be moved. They learn to compute safe balance for loads of men and equipment, proper lashing for air-transported equipment, and aërial delivery procedures.

Two day's training in the fifth week complete the airborne course for officers and NCO's. On one of these days they make a "jumpmaster" parachute drop over an unfamiliar drop zone.

"Paratroopers today are being geared to meet the demands of atomic warfare. Authorities believe it will be airborne troops that will move in after an atomic attack, catching the enemy while he is still under the shock of the blast. . . .

"Among the many indications of airborne units' expanding part in our national defense is that newly commissioned Regular Army lieutenants are now required to take either airborne or Ranger training. Officials at Fort Benning say airborne troops have great striking power and that their mere presence ties down many enemy reserves who must be alert for attack from the sky."

Jumpmaster training teaches officers and NCO's to know the right time and place for paratroopers to jump. The ability to find a designated destination builds confidence in jumpmasters. This is needed, for theirs is the responsibility for "jumping" their men in a safe and efficient manner.

Physical training is an important item in the airborne program since experience has proved there is a direct connection between the physical condition of the student and the injury rate. This rate at Fort Benning has been reduced from 14 per cent in 1943 to approximately two-tenths of one per cent at the present time.

COLONEL Cagwin sums up the program conducted by his department when he says: "The techniques we teach and the procedures we employ are products of over thirteen years of experience, not only at Fort Benning but throughout the Army. By vigilant examination of students' performance, constant study of malfunction and injury rates, and continuing scrutiny of teaching methods and instructors, we endeavor to improve our techniques and the quality of our product.

"The development of new types of airborne equipment can be expected, and our instruction will be geared to keep the students abreast of new developments. Our objective is to turn out the best possible paratroopers, in the time allotted for their training, without compromising on safety or relaxing the high standards of performance set by our predecessors."

Airborne troops have written their own history, such as the 82nd Airborne Division's assault on the strategic islands of Sicily, the Salerno beachhead, and the battles at Anzio, Mt. Samucro, and the Volturno River. The 82nd and the 101st Airborne Divisions played a major rôle on the Normandy beachhead.

Today there are two airborne divisions in the United States, the 82nd at Fort Bragg, N. C., and the 11th at Fort Campbell, Ky. The 508th Airborne Regimental Combat Team also is assigned to Fort Campbell, and a second regimental combat team, the 187th, is in the Far East.

Industry and Defense

Close coöperation between American industry and the armed forces has been developed and must be maintained if the United States is to be assured the maximum defense potential

Charles A. Dana

Chairman of the Board, Dana Corporation, Toledo, Ohio

AMONG America's greatest assets is a close working relationship between industry and the national defense which in recent years has reached a state of coördination and efficiency that has no counterpart anywhere else in the world.

Because success in modern warfare relies as much on the production line as the battlefield, there can be no substitute for this close, efficient, working relationship. The military must catalog what it needs to win in an emergency, and industry must maintain the know-how and flexibility to be able to convert its peacetime facilities to production of these needs whenever required.

American industry turned in a miraculous performance during both World Wars, and no letdown occurred during the more recent Korean conflict. The production rates attained could not have been reached, however, were it not for the preplanning that existed between the military and industry and the state of readiness and cooperation that had been developed in so far as the various production lines were concerned.

AMERICA'S vast industrial potential comprises many individuals, establishments, and elements. There are large and small industrial units within its framework, but each has a definite, specialized part in the scheme of things and a great responsibility for maintaining the Nation's state of readiness.

Certainly the writer cannot speak specifically for all of them regarding their participation in this community of interest, but I can speak for the Dana Corporation and outline what it has done, is doing, and can do in the future by way of converting its commercial manufacturing facilities to wartime production should another emergency call for partial or total support of American industry.

This is the first of a series of articles which will be published in this magazine as case histories in industrial preparedness. Throughout the series the achievements of leading elements of American industry will be recounted, both as they relate to past performance and to planning for future emergency armament production.

The American economy is unique in that in normal times it does not have a private armament industry. Due to the force of present circumstances, today much of the strength of that economy is devoted to ordnance production.

But the great problem of industrial preparedness is in keeping available the know-how and the facilities for instant armament production in time of emergency. This series of articles will attempt to stress the need for constant readiness, both of personnel and facilities for arms production in time of trouble.

The Dana Corporation is the outgrowth of a company founded in 1904 by the late Clarence W. Spicer in Plainfield, N. J., to manufacture the first successful universal joint and propeller shaft for automotive use.

Spicer universal joints in the larger sizes have been used for many years in medium and heavy-duty trucks, buses, railcars, and in industrial applications. Also manufactured in large volume are smaller sizes of universal joints used in passenger cars, light and medium trucks and buses, and in industrial applications.

THE company likewise manufactures all forms of automotive transmissions, auxiliary transmissions, gear boxes of special design, and torque converters for use in trucks, buses, and in miscellaneous industrial applications, as well as power take-offs for use in trucks, gear-reduction units, etc.

It manufactures axles for passenger cars, light trucks, and taxicabs, along with clutches for passenger cars, trucks and farm implement equipment, and for industrial units. Other peacetime products include heat-treated frames for heavy-duty trucks; passenger car frames; metal stampings for many diversified products; and alloy, stainless, armor, and carbon steel and titanium forgings in intricate and complicated designs for the automotive, truck, railroad, agricultural, conveyor, aircraft, and other industries.

In World War I our company was among those supplying this country and its allies with various needed automotive components used by the military,

all keyed to the products we had manufactured prior to the start of hostilities.

After the big production push of the First World War, military-industrial planning and coördination suffered serious deterioration. This dangerous "do-nothing" condition existed until the rise of Hitler in Germany, which touched off a wave of apprehension leading, fortunately, to a close integration of American industry and planning with the needs of the military.

This was reflected in the chronology of the company's work for the military which was resumed in 1933 when Spicer engineers were asked to design a transmission and final drive for light tanks. This was a natural, fully justified assignment for them because over their many years of peacetime work they had become outstanding experts in the field of commercial automotive transmission design.

A SYNCHRONIZER was developed for the tank unit in 1937 as an extension of the original engineering work, but it wasn't until 1939 that the company tooled up and went into volume production of synchronized light-tank transmissions and final drives for the Army.

The important facts here are that, first, the Army took full advantage of the company's specialized knowledge in the automotive-transmission field and, secondly, that under the program set up we were in a state of readiness to produce this important tank component for six full years—able when finally called upon to do so without delay.

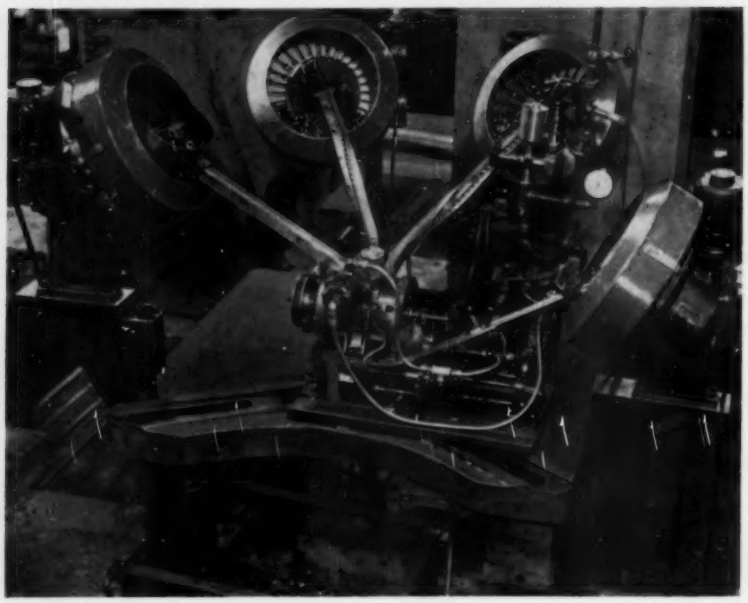
Resorting to the placement of contracts with companies according to their peacetime production or research and development specialties became a fortunate rule with the military procurement agencies prior to World War II. It insured not only maximum efficiency and speed in getting programs under way but also that the end product would be properly engineered and of the highest possible quality.

This policy was reflected in a contract placed with our company in 1940 when we were asked to redesign a synchronized transmission and final drive for medium tanks.

This component was originally developed by the Army at its Rock Island Arsenal, but at the time we entered the scene some one with highly specialized knowledge in this particular field was needed to refine and polish the design before it could be placed in production.

In the case of this transmission and final drive for medium tanks the company's assignment was confined wholly to redesign and extended development. It was at no time intended that we should manufacture the units. After company engineers had completed their assignments, actual manufacture of the transmissions and final drives went to tank-production plants operated by other manufacturers who were specialists in fabricating and assembling completed vehicles.

Specially designed machinery is used to assemble driven-plate spring dampers for Spicer Brown-Lipe clutches at the Auburn Clutch Division, Auburn, Ind.



THIS type of coöperation and close coördination within industry, which takes advantage of specialized ability to the greatest possible extent, is without doubt a highly significant and important factor in this Nation's over-all defense picture.

In 1940 we also redesigned a 5-speed transmission for Valentine light tanks produced in Canada, a unit manufactured in that allied country throughout World War II.

During the time of this country's actual participation in the war, our know-how in the automotive and tank-transmission field was also utilized by the Government in such things as the redesign and production of a synchronized light-tank transmission for use in LVT amphibious vehicles produced by Food Machinery Company.

Design and development work on torque converters for the military was undertaken by our firm in 1939 when we and five other companies were asked by Army Ordnance to design an automatic transmission for the T7 tank, later to be designated the T70 medium. We submitted a 3-stage converter acceptable to Ordnance which subsequently became the standard for this piece of equipment.

THE T70, never in actual production, was superseded by the Hellcat 18-ton medium for which we supplied thousands of 3-stage torque converters.

Our plants were engaged in the design, development, and production of tank torque converters throughout World War II, and our preparation and know-how for this work was such that specific types could be phased in and out of production almost at will, without undue delay or loss of manufacturing efficiency.

Dana's specialized experience was

also utilized in 1939 in connection with half-track components, the company being called upon to design and produce transmissions, transfer cases, clutches, and final drives for Autocar, White, and Diamond T vehicles. Half-tracks were in production when this country entered the war, and the manufacture of parts for them was continued by our plants throughout the conflict.

From 1940 to the end of World War II, other automotive-type components designed or produced by the company included 3-speed transmissions with high reverse gear for barrage-balloon trucks; transmissions for transport carriers; many different transmissions and auxiliaries for special-purpose vehicles; special transmissions for helicopters, etc.

Dana also played a part in the evolution of the famous jeep. In 1940, when the design and specifications for this vehicle were at a point where pilot models could be constructed, the company was called upon by the Government to use its know-how in the design and fabrication of the 4-wheel-drive front and rear axle needed for the unit.

AFTER numerous conferences with the various component manufacturers involved and with Army Ordnance personnel, we were awarded a development contract and orders for fifty-three sample sets of material. Ordnance subsequently awarded contracts for 1,500 vehicles each to three automobile manufacturers. All 4,500 of these vehicles employed Spicer axles, transfer cases, and propeller shafts.

Willys-Overland was ultimately named the prime supplier of the jeep and was awarded a production order for 18,000 units. Ford Motor Company was designated as a second source to build jeeps to Willys' prints. We, in turn, licensed Ford to produce axles, transfer cases, and propeller shafts to our specifications.

Volume production of the jeep achieved during 1941 was maintained throughout World War II and the Korean war, and production of these versatile little vehicles continues today, still with our participation and help.

Automotive-type parts, although an extremely important part of our World War II production, were by no means the only items manufactured by Dana and its wholly owned subsidiaries, some of which were specialists in industrial lines outside the stricter limits of the automotive field.

A battery of presses produces a huge volume of heat-treated frames for heavy-duty trucks at the Parish Pressed Steel Company, Reading, Pa.

For example, work of the General Drop Forge Company plant at Buffalo included production of steel drop forgings for Watervliet Arsenal, naval aircraft engines, submarine and aircraft torpedoes, gun carriages, trucks, and miscellaneous vehicles.

Parish Pressed Steel Company, a wholly owned subsidiary, also contributed numerous items of a critical nature to the military. In 1940 and 1941, prior to Pearl Harbor, Parish was fabricating 75-mm. gun carriages. During the actual period of hostilities it manufactured 57-mm. carriages as well as 105-mm. gun mounts, 90-mm. carriage trails, and ammunition accessories.

Considerable research was done on related military items, and this subsidiary did a great deal of work on a special process for preliminary straightening of armor plate.

Field ranges and steel helmets were produced by Parish for the Army Quartermaster Corps, while many different types and sizes of wire reels were made for the Army Signal Corps. Other items were aluminum cowling and skins for aircraft and miscellaneous parts for heavy-duty trucks.

Our research and development facilities were also called upon for work in various and sundry lines for which they were well qualified on the basis of commercial experience. A great deal of this work involved research on molybdenum, nickel chrome, vanadium, and the various types of national-emergency steels. The company was very active in the development of gear steels, many of which were adopted as the standards for their particular fields.

DANA'S facilities were greatly increased during and after World War II. Since 1940 its manufacturing area has been expanded fourfold. This growth has been paralleled by a corresponding increase of engineering facilities. Divisions and subsidiaries are now located in Toledo, Ohio, Pottstown and Reading, Pa., Hillsdale and Lansing, Mich., Buffalo, N. Y., and Fort Wayne, Auburn, and Marion, Ind. The Dana Corporation also has substantial interests in industrial enterprises in Canada, England, France, and Australia.

All our facilities are maintained on a stand-by basis ready to be converted to military production when needed without extensive retooling. Certain of the newer increases were made specifically to accommodate military production. Constant liaison is maintained with the military procurement agencies.

Many of our newer facilities participated in production for Korea, which ran pretty much the gamut of our over-

all current capabilities. Production included scores of different automotive and tank components, 105-mm. gun carriages, land mines of advanced design, 60-mm. mortar shell, research and development work, and experimental parts for new artillery designs, wire reels, special high-strength suspension-arm assembles for a newly designed cargo carrier, elevating arcs for 90-mm. tank guns, articles for the frames of heavy-duty vehicles, fuel tanks for jet aircraft, quarter-ton trailers, and muzzle brakes and blast-deflector weldments for 90-mm. guns.

WE also conducted an experimental program covering forging and heat treating of titanium metal. These forgings, mass produced for aircraft jet engines, weighed half as much as steel forgings with comparable physical properties and were considerably more resistant to heat and corrosion.

Developed, too, was a process enabling the Cadillac Tank Arsenal to mass produce heat-treated louvre forgings to armor-steel specifications. These replaced old steel castings used in tank armor to protect tracks and other vital parts and are said to have averted a bottleneck in steel castings.

"American industry turned in a miraculous performance during both World Wars, and no letdown occurred during the more recent Korean conflict. The production rates attained could not have been reached, however, were it not for the preplanning that existed between the military and industry and the state of readiness and coöperation that had been developed in so far as the various production lines were concerned."

Still other contributions to the Korean effort included tank crankshafts, collars for tank hatches, various gun-part forgings, aircraft forgings and gears, and spline and coupling shafts for aircraft reciprocating and jet engines.

Many tests were conducted on boron steels and their results pooled with those of other manufacturers. Dana engineers served on nine national technical committees dealing with defense products while at the same time performing their regular design and engineering functions for the company.

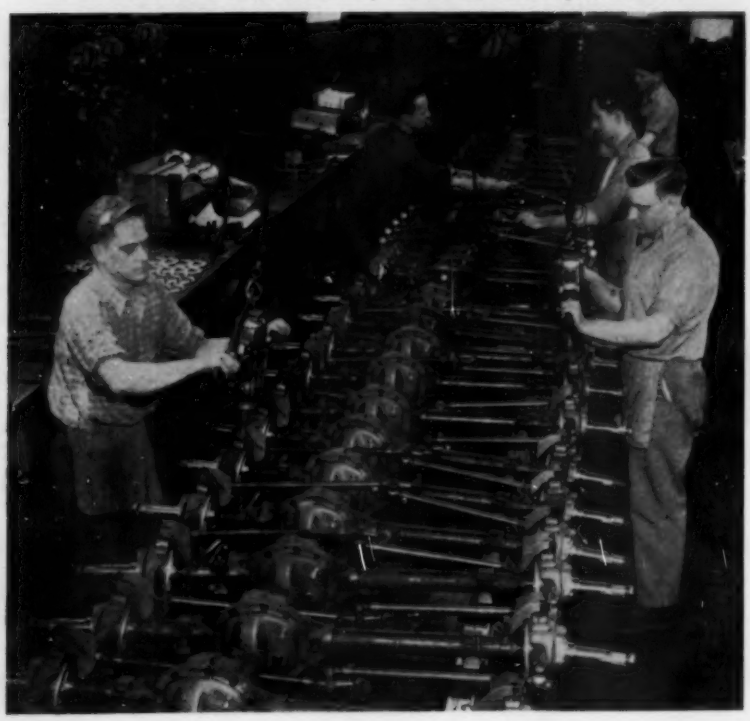
Obviously we produced a greater diversity of items for the Korean conflict than we manufactured during World War II. This undoubtedly can be put down as the natural outgrowth of that World War II experience itself. As our productive capacity expanded, know-how increased apace and, because we worked so closely and continuously with the defense procurement agencies and other production industries, diversification was a natural process which brought with it a minimum of problems in the fields of engineering and actual production.

This fact, I further believe, adequately dramatizes the importance and effectiveness of a close working relationship between industry and the military and the policy of the latter to use specialized plants for the production of specialized items wherever possible.

Although the guns have been stilled in Korea, the basic dangers that have faced the United States since before the start of World War II remain largely unresolved. It is extremely fortunate that the experiences of Dana may be multiplied many times.

Dana has a diversity of plants and locations, a diversified line of essential products, a wealth of specialized know-how in its particular field, and is fully prepared to adapt these assets quickly and efficiently to the Nation's needs as they arise. What can be committed for the Dana Corporation in this regard can be said with equal correctness of American industry as a whole.

Workmen at the Salisbury Axle Division, Fort Wayne, Ind., complete some of the thousands of axles which daily roll off the efficient production lines.

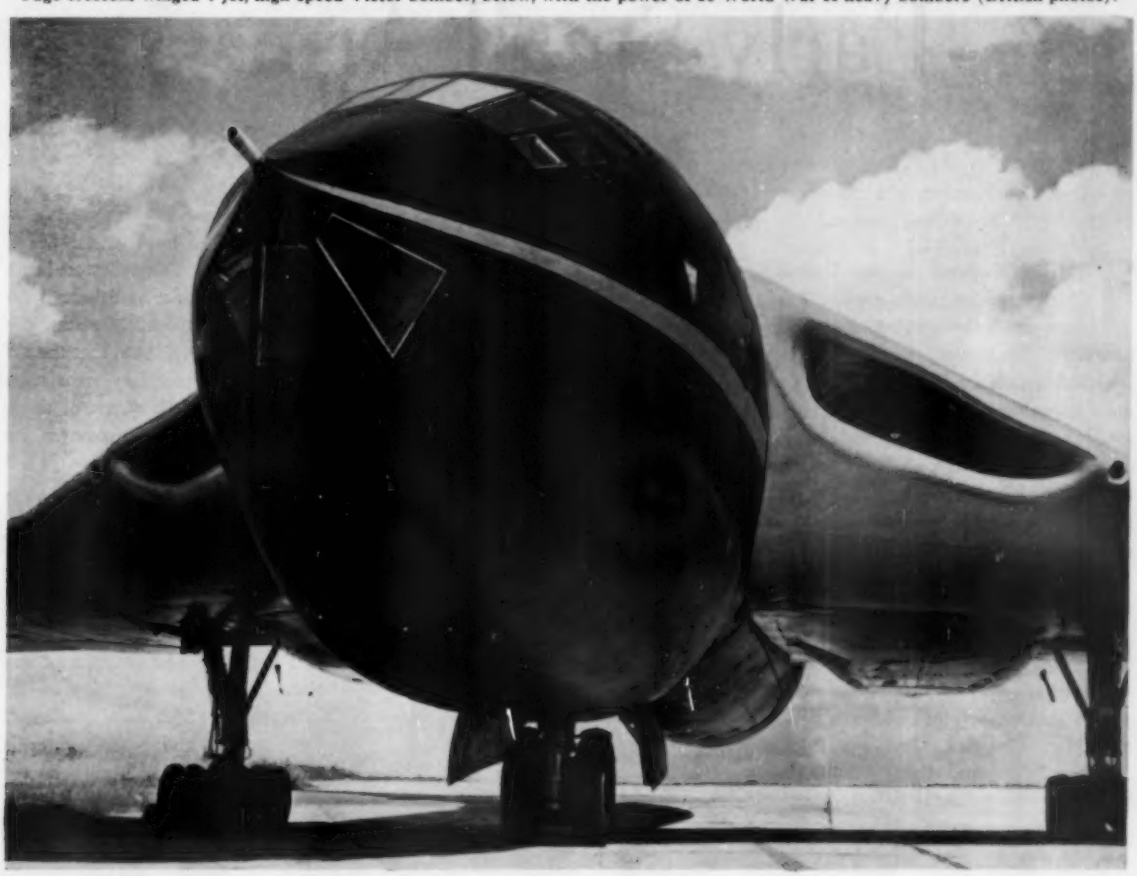


ANY nation foolish enough to attack the United States in future years will find us a Nation better trained and equipped than ever before to meet such a challenge. Today, American industry, through its experience, resourcefulness, and its demonstrated ability to cooperate and coördinate, is a tough fighting machine, as practiced and dedicated as the magnificent armed forces this country has always been able to muster in emergencies.

As long as industry and the military remain in the close relationship that has existed since before World War II, this country will never find itself bowing down to a conqueror.

Giant and Giant Killer

Possible prototype of future small, light fighters is the British Folland Midge, above, weighing only 6,000 pounds, with a wing-spread of about 20 feet, and a speed of over 600 m.p.h. on its single jet engine. At the other extreme is the British Handley Page crescent-winged 4-jet, high-speed Victor bomber, below, with the power of 10 World War II heavy bombers (British photos).



Right to left: Krag Bowie-bayonet and sheath, 1900; Springfield knife and cover, 1880; Ames knife and sheath, 1849; Hicks knife and sheath; tomahawk.

Early Small Arms

Col. B. R. Lewis

THE rifles used in the United States service since about 1812 are well known to collectors and historians. Such types were standardized and manufactured in considerable quantities either at Government armories or under contract. The latter method of procurement was prescribed, in the Act of 1808 for arming the militia, for arms bought from Federal funds and to be delivered to the several States.

However, the rifles purchased under 1808 contracts and in 1792 and earlier are very little known. In general, they were ordered in small lots from local gunsmiths. Those ordered in 1808 were intended to be patterned after the then-new Harper's Ferry rifle, Model 1804. The hardware and the half-stock of that rifle were generally followed.

The earlier contract rifles were simply "Kentucky" or "Pennsylvania" rifles, usually but not necessarily made with the caliber of the service rifle—0.525-inch.

The only distinguishing marks on such pieces are the "US" and "P" marks put on by the Government inspector, usually on the barrel only. Partial lists of contractors exist. Few collectors boast of having such a rifle, and there is no specimen in the National Museum.

It is not surprising, then, that the accoutrements and secondary arms used by the riflemen in the Army of those days are almost entirely unknown, or at least unrecognized.

Colonel Lewis is an expert in the field of small arms and a well-known weapons historian. His excellent series of articles on United States machine guns appeared in the 1945 and 1946 issues of ORDNANCE, *and his more recent "Explosive Bullets" was published in the May-June 1954 issue. At present Colonel Lewis is on duty with the Ordnance Section, Headquarters, Korean Communications Zone.*

FROM the first mention of riflemen in the Army, knives and tomahawks were listed as more or less standard issue. In a letter to Gen. J. S. Smith, George W. P. Custis, Washington's adopted son, described riflemen of the Revolutionary period as follows:

"Riflemen of Morgan's Regiment wore . . . blue and white uniform, hat turned up at the side with buck's tail . . . belt, tomahawk, and knife . . . On the colors of the Rifle Corps were the tomahawk instead of a spear."

Tomahawks were carried on arsenal inventories and were issued to troops during Wayne's campaign in 1792, to the Lewis and Clark expedition, and later during the War of 1812. The tomahawk was used by most militia and other troops on frontier duty. Several arsenals and depots still had them in stock in the 1830's.

THE original tomahawk used by the North American Indians of the eastern seaboard was a wooden club having for a head either a plain knot or a knob fitted with one or more metal or flint spikes. The rifleman's tomahawk was a light camp ax or hatchet of the size then known as a "half ax." Such hatchets were used in Europe by engineer and sapper troops.

The type used in the U.S. service is illustrated below. This example is like several found at Ticonderoga. It is marked "Baldenburg" in a circle around some sort of medallion now obliterated. Since Baldenburg is near Cologne, this hatchet, like most of those used here, was made in Europe.

A large figure "2" is stamped in the metal. This might indicate issue to the 2nd Rangers, a unit armed with rifles. Hatchets of this general type were very popular with the Indians, taking the place of their wooden tomahawks to a large extent, and becoming an important article of trade.

Such a trade-type tomahawk of the late eighteenth century is also pictured below. Others had a tobacco pipe for a poll. Hatchet heads of British, French, and Spanish designs can be identified in collections of Indian material. These were mostly imported, but some were copies made by local blacksmiths.

The knives first issued to riflemen were described simply as "butcher knives." They had plain wooden handles and 8- to 10-inch, thin, flat, single-edged blades, about 1 to 1½ inches wide. The Army later tended to follow the pattern set by James Bowie.

An early example of such a knife, made by contractor A. G. Hicks, cutler and tool maker of Cleveland, Ohio, is shown below. It is likely that this knife was made for the Allegany Arsenal at Pittsburgh during the period 1830-1850, when Ordnance procurement for the region west of the mountains was centered there.

The only known reference to Hicks near that time seems to be late in his life. The *Cleveland Leader* of March 18, 1859, said:

"The Forest City and Pike's Peak Company left town last evening on the steamer, MAY QUEEN, en route for the gold regions. They are men of the right stamp to succeed. Commander in chief, Andrew G. Hicks, Esq., is a man of much general information. Being an old traveler, he is eminently qualified to direct an enterprise of this description."

A somewhat heavier knife was made under contract by N. P. Ames, Cabotville, Mass. This knife, like the first example, is double-edged toward the point. The knives of the Ames contract were said to have been intended for the Fremont expedition, but were not delivered in time.

Another somewhat similar knife, marked "Collins & Co. Hartford" appears below. It probably was made between 1850 and 1860. It has a single cutting edge and is of a pattern that was followed in general until the 1880's, when the last type of rifleman's knife, (second from right on page 570) was made at Springfield Armory.

DURING the Civil War, a Bowie-knife bayonet was provided for the Navy "Dahlgren" or "Plymouth" rifle. The idea was still alive in 1900, when a "Bowie-bayonet" (far right, below) was made for the Krag-Jorgenson rifle, to be used in the Philippines.

In the actions of formal warfare, the knife could not compete with the effective rifle-musket, though it died hard. The *Richmond Daily Examiner,* on August 13, 1861, carried the following news item: "The Tiger Rifles, Wheat's Battalion, charged with Bowie knives at Manassas. But 26 out of 83 rank and file survive."

Right to left: top, rifleman's tomahawk; bottom, trade toma hawk, both of the 18th century; Hicks knife and sheath, 1830-1850; Ames knife and holder, 1849; Collins knife and sheath, 1850-1860; Dahlgren Bowie-bayonet and sheath, 1863.

Key to Conversion

Industry Integration Committees, which helped solve many production problems in World War II, may be called upon to speed our industrial mobilization in the event of any future all-out war emergency

Lieut. Col. George S. Quick

THE embattled farmer of Revolutionary War days, who left his plow to fire the shot heard round the world, would not fit easily into today's military preparedness picture. Nor would the mere shouldering of rifles by a "million men springing to arms overnight" be very impressive by modern defense standards.

Today, readiness for war is inextricably interwoven with the ability of our national industrial structure quickly to bring into existence large quantities of munitions.

One of the important devices for achieving this aim in World War II and in the Korean crisis was the Ordnance-industry integration committee. So successful were these committees that they can be expected to provide powerful and effective assistance in industrial mobilization in any future great war.

At present it is our national-defense policy to rely upon our ability to shift quickly to large-scale war production rather than to create and maintain large stocks of military equipment. Many reasons are advanced by the proponents of this concept: rapid obsolescence of weapons in being, scope and rate of new developments in weapons and war equipment, tremendous cost of creating large stocks of munitions, desirability of maintaining a high rate of production of consumer goods, and numerous others.

Without considering the various arguments for and against this "quick-shift" policy, it can be accepted as that to which we are pledged, and its implications can be examined. Basic to the success of the policy is its relationship to a statement by Dwight D. Eisenhower, then retiring as Chief of Staff of the Army, in his final report on February 7, 1948:

"What we are able or not able to do within the first sixty days of another war will be decisive in its determination of our ability to carry the war to a successful conclusion."

It is only reasonable to interpret this statement by General Eisenhower as applicable to our industrial-mobilization effectiveness as well as our combat effectiveness in the first sixty days of another war.

The problem of shifting quickly from a high rate of civilian-type production to a high rate of war production has been the foundation for most of the industrial-mobilization planning which has taken place since World War I. Throughout the 'twenties and 'thirties studies were carried on, primarily within the procurement districts of the Army Ordnance Department, which had as their objective an understanding of the American industrial structure and its adaptability to war.

As with other aspects of preparedness, lack of funds prevented the degree of progress in this effort that would have been desirable. However, some progress was made, and much of the information which was obtained proved useful in World War II.

The experience in that conflict gave to the procurement agencies of the military establishment, and to industry, a much clearer understanding of the time factors involved in shifting from peacetime to wartime production than they had ever before possessed. Despite heroic efforts by both industry and government, it was found that the process of changing from the production of automobiles to tanks, for example, was laborious and time-consuming. As Charles E. Wilson, then president of General Motors, put it:

"WHEN you convert one of our factories, you move everything out and start with blank space. Out of a long row of intricate machines on the production line a certain percentage may be used in the manufacture of a war product, depending on what that war product is. But the production line will necessarily consist mainly of new, special-purpose machines along with any of the old machines that can be rebuilt for the new process."

Since World War II, much more attention has been focused upon the industrial-mobilization problem than ever before. Much talented manpower and considerable amounts of money have been devoted to the subject, and numerous substantial and significant publications have appeared from such agencies as the Industrial College of the Armed

Colonel Quick is a former instructor in ordnance at the United States Military Academy, West Point, N. Y. He was recently reassigned to the Command and General Staff College, Fort Leavenworth, Kans.

Forces, the Legislative Reference Service of the Library of Congress, the United States Department of Commerce, and from various economists, engineers, business executives, journalists, and other writers.

MUCH of this material is of great value, but to a considerable extent it deals with the higher levels of industrial, economic, and social planning and does not approach the single-factory level. However, the basic problem of the "quick switch" must be solved at the single-factory level in terms of machine tools, handling equipment, building space, qualified personnel, and similar factors.

The knowledge necessary for solving the problem must be available at the single-factory level before conversion becomes necessary. Lieut. Gen. Sir Ronald Weeks, an important British writer in this field, states:

"The U.S.A. authorities point out that industrial mobilization took 1½ to 2 years to get into gear in 1940-1942. Owing to the probabilities of new weapons, no such period of grace will be given again; companies should know *now* what is expected of them, what to make, how much, and for whom, before the dreadful day (mobilization day) arrives."

Though there has been much study and planning devoted to solving the "big-picture" problems associated with industrial mobilization, relatively little has been done at the plant and product level. Perhaps the greatest single step in this direction was the device employed by Army Ordnance in World War II which came to be known as the Ordnance-industry integration committee.

IN April 1942, production of the M43 mechanical time fuze, widely used on antiaircraft artillery ammunition, was in an unsatisfactory relationship to the greatly expanded requirements that had resulted from German attacks on England, our preparations for antiaircraft defense of the United States, and from other causes. Maj. Gen. L. H. Campbell, Jr., who within another month was to become Chief of Ordnance, determined upon a special program for the purpose of getting increased production from the existing facilities of the seven manufacturers who held contracts for the M43 fuze.

Rather than continuing to treat them as separate plants with individual operations he decided to group them as an integrated organization producing a common item. Representatives of the different contractors would coöperate closely with one another, exchanging tools, parts, materials, and even the services of key personnel to get a greater total output from the plants as a whole.

The entire program was to be carried out under the sponsorship of the Ordnance Department, with an Ordnance officer as committee chairman.

The purposes of the committees, as described in a letter from General Campbell to Donald M. Nelson, Chief of the War Production Board, would be "to provide for the interchange between contractors of information regarding production techniques and processes; to consider and make recommendations with respect to problems of production and supplies of materials and components; and to consider and recommend measures for the best integration of the facilities of the several manufacturers so as to attain maximum efficiency in the utilization of such facilities."

FROM the first, the integration committee proved a highly effective means of increasing the total output of a given item within the limits of existing facilities. In the case of the M43 fuze, the first meetings resulted in tabulations of component capacities that existed among the various contractors and subcontractors.

It was immediately noted that certain

Aided by industry-military coördination, the Starfire F-94C jet interceptor, one of our newest air-to-air weapons, rolls from the production line on schedule.

components were in over supply, and others in short supply, as viewed from the perspective of an integrated industry operation. It was possible to shift components among plants and to de-emphasize production of certain components in favor of others to balance the total supply. These actions alone resulted in a net increase in output without any expansion of facilities.

In addition, the committee encouraged mutual visitation among contractor personnel so that each contractor could benefit from the operations of the others. These visits were not restricted to key personnel. Foremen and production-line workers from new producers worked side by side with operators in the older plants to gain on-the-job experience.

THE engineers and production experts of the various contractors met to analyze carefully the materials, methods, standards, and specifications involved in their production of the M43 fuze. Results of these conferences were soon evident in increased standardization of materials and methods among the various plants and in a simplification of standards and specifications to get a more uniform, though technically acceptable, end product.

By interchange of components, training, technical knowledge, and the actual services of key personnel, the production of the M43 fuze, as a result of committee activity, quickly skyrocketed.

According to General Campbell, in his book, "The Industry-Ordnance Team": "The M43 Mechanical Time Fuze Committee not only met increased requirements but almost doubled its output per month within about four months of its formation. Furthermore, stamped gears costing about $2 a thousand were substituted for cut gears costing $18 a thousand. Drawn pinions costing $5 a thousand were used instead of milled pinions at $30 a thousand. These and other similar substantial savings, effected through production engineering of the item, reduced its cost twenty-eight per cent. At the same time, the performance of the fuze was greatly improved."

The obvious effectiveness of the industry integration committee device led to the rapid formation of other committees within the succeeding months of 1942. By June 1943 a total of 131 committees were in operation covering various end items of ammunition, small arms, tanks, automotive equipment, fire-control instruments, guns, and gun carriages.

During World War II more than 250 committees were formed, organizing the efforts of some 3,200 prime contractors and an estimated 15,000 subcontractors.

Formally organized coöperation of manufacturers on such a scale, involving as it did the greater proportion of the total industrial capacity of the Nation, had never before been known in this country. Such coöperation was the antithesis of our traditional antitrust policy, and during the early period of organization many a manufacturer was openly apprehensive of possible prosecution under the antitrust laws for his participation in committee activities.

In practice, the fact that the committees were organized to consider only production problems, without reference to marketing and distribution, and that they functioned under the chairmanship of an Ordnance officer considerably reduced the likelihood of prosecution. However, there is no doubt that some danger of prosecution did exist.

The first protection for committee members came in the form of a letter, dated May 1, 1942, from Francis Biddle, Attorney General of the United States. In this letter the Attorney General gave his assurances that as long as the committees operated only under the sponsorship of Army Ordnance and for the purpose of maximizing war production the committee members would not be prosecuted for violation of the antitrust laws.

This guarantee was given statutory basis with the passage of the Small Business Mobilization Act of 1942 (Public Law 603, Seventy-seventh Congress) on June 11, 1942. Section 12 of that act provided that no prosecution or civil action would be initiated under the antitrust laws or the Federal Trade Commission Act against any person or persons if the Chairman of the War Production Board had certified to the Attorney General that the acts of that person or persons were requisite to the prosecution of the war.

Such a certificate was executed on September 7, 1942, by Mr. Nelson, Chairman of the War Production Board, and from that time until the end of the war the manufacturers were assured that their coöperation with others in the integration-committee program could not be considered as the basis for antitrust action against them.

The amazing record of the Ordnance-industry integration committees is familiar to almost all those who participated in the Ordnance production effort during World War II. They served as ideal centers for information regarding particular end items and were able to to contribute important data regarding contractor and subcontractor plants whenever changes in production schedules were being worked out.

They consistently added to production by their integration of components and capacities on an industry-wide basis. By exchanging information on actual production methods they constantly improved the functioning of the less effective producers.

The coöperation of engineers, technicians, and production experts toward the common goal of greater production of a given item brought forth a great flood of production engineering improvements and beneficial design modifications that greatly increased the quantity and quality of production.

In fact, this coöperation of qualified experts was such that in almost every case production rates for end items were soon much greater than those the planners of the production facilities concerned had anticipated.

FOR example, the construction of facilities for the production of trinitrotoluene was based on a rated capacity of 30,000 pounds per line per day. A single process change, which resulted from the type of coöperation and exchange which integration committees stimulated and made possible, enabled

the average TNT line to produce more than 60,000 pounds a day with the result that certain TNT facilities which were in the process of construction never had to be completed.

This "improvement factor," so often demonstrated by American scientists and engineers, is one of the great assets of the Nation in any mobilization. It is a tangible factor—but not so tangible that it can be measured. However, any carefully drawn estimate of productive output could safely contain a plus allowance for the contribution of this "ingenuity" factor to the ultimate result.

FOR example, if in military production planning for a new item of ammunition the planners conclude that with known tools, equipment, and methods they could turn out 100,000 units monthly, it can safely be assumed that when actual production schedules are let and production started, very soon the rate will be 100,000 units plus.

The added production would result from the improvements made when the technicians and engineers began to examine the performance of equipment and effectiveness of methods in an actual, sustained, mass-production situation. It is probable that a plus factor of ten per cent could very safely be allowed for almost all types of production which, under mobilization, would suddenly be brought under the powerful focus of the talents of the engineers, technicians, and production experts.

The perpetuation of this characteristic is of great importance. In time of actual industrial mobilization, the integration committee affords an ideal agency for its encouragement and development. Within the committee the experts of industry are brought into direct contact with the problems pertaining to a particular item, and by focusing upon them they very frequently can provide a solution that gives greater output at less cost.

Industry integration committees were purely wartime organizations, and when World War II ended all of them became inactive. Not until the outbreak of fighting in Korea in 1950 was consideration given to the organization of new committees.

"The amazing record of the Ordnance-industry integration committees is familiar to almost all those who participated in the Ordnance production effort during World War II . . . They consistently added to production by their integration of components and capacities on an industry-wide basis."

At that time the Nation again faced the necessity for very quickly shifting to a high rate of munitions production, and the success of the integration-committee device was fresh in the minds of many of the officers and key civilians within the Ordnance Corps who had responsibility for the success of the new programs.

Though more than twenty committees eventually were formed, the program was quite different from that which had been experienced in World War II. The new committees required individual prior approval by the Attorney General, while in World War II Ordnance could organize committees at will, merely notifying the Attorney General that a committee had been formed.

In addition, there was apparent reluctance on the part of the Attorney General to approve a new committee except after exhaustive justification by Ordnance. Adequate statutory protection for the industry committee members was contained in the Defense Production Act of 1950, as amended, but the committee device never reached the importance it attained in World War II.

IN view of the evidence, a policy which does not encourage integration committees as a permanent part of industrial-mobilization planning and as a key device in attaining and maintaining a high level of armament production, appears difficult to justify. An armament-production program, in the final analysis, is always basically the production of specific end items in particular plants or groups of plants.

In planning for a high level of armament production it is not sufficient to formulate policies and procedures in the broad terms of manpower, allocation of materials, establishment of priorities, and similar fields.

The type of planning that will permit rapid shifting from peacetime to wartime production is the type that extends down to actual production lines in specific plants turning out particular end items.

It is at this level, and at this level only, that the full complex of production problems involved in producing a particular item is faced, and it is largely at this level that the information can be obtained which will permit the solving of these problems quickly and effectively.

ANY type of industrial-mobilization planning which does not extend down to the specific item in a specific plant must be largely a paper plan, with many of the serious production problems yet to be faced and solved when the plan is put into effect.

The objective of integration committees, as originally organized, was to obtain greater production from a given amount of plant by considering all producers of an item or closely allied items as an integrated organization striving for a common goal of maximizing combined output.

The integration process is essentially one of balancing facilities and components in such a way that any unused capacity or materials are put into effective use by some member of the committee. The process of centralizing information which is required to attain this objective is such that it places the committee headquarters in possession of a wide range of factual information that can be used for a variety of purposes, and often for purposes outside the scope of activity of the integration committee.

A nation facing the need to arm quickly in the face of great peril must get the most out of what it has if it is to attain that objective. The industry integration committee, by encouraging manufacturers to solve the problems which arise in an armament expansion program by means of mutual assistance and coöperation, can do much to help attain that goal.

Month by Month: Highlights of the National Defense

What Price Korea?

A "tentative final report" recently issued by the Defense Department, shows nearly 140,000 United States casualties in Korea—33,629 deaths and 103,285 wounded—during the period from June 25, 1950, to July 27, 1953.

In addition, 5,133 of our men were reported captured or missing but returned to military control; 21 refused repatriation; and 24 are still missing.

A complete breakdown reveals the following figures:

> *Army casualties were 19,334 killed in action, 1,930 dead of wounds, and 6,440 listed as missing in action and known or presumed dead. The number of Army men wounded in action was 77,596.*

Navy casualties were 279 killed in action, 23 dead of wounds, and 156 recorded as missing in action and known or presumed dead. The number of Navy men wounded in action was 1,576. Nine Navy personnel are currently missing.

Marine Corps casualties were 3,308 killed in action, 537 dead of wounds, and 442 either missing in action or known or presumed dead. The number of Marine Corps men wounded in action was 23,744.

Air Force casualties were 379 killed in action, 11 dead of wounds, and 810 missing in action or known or presumed dead. The number of Air Force personnel wounded in action was 368. Fifteen airmen are currently missing.

This is the high manpower cost of the only war in our history where defeat of the enemy was not the political goal.

This is the frightful price of our short-sighted policy of stalemate and of our muddleheaded and naïve policy of disarming immediately after World War II.

Atomic Weapons to the Fore

"I don't know of a more efficient weapon from the viewpoint of the combat infantryman."

Maj. Gen. James M. Gavin, Assistant Chief of Staff for Operations was referring to that ingenious product of the Ordnance-Industry Team, the 280-mm. atomic cannon.

> *He added that it was a great pity that the mighty atomic cannon (able to fire conventional as well as atomic shells) had not been developed in time for the Korean war. It could have helped to reduce the casualty rate among combat infantrymen.*

About fifty of the huge 85-ton all-weather weapons have been delivered, and of these an estimated thirty-six are now in the European theater. The Army was the first to develop such a powerful weapon and was the first to anticipate an atomic battlefield. The 280 has been invaluable in working out new tactics and organization for nuclear warfare.

A few months ago, during the "Battle Royal" maneuvers in West Germany, one of the big 280's partially turned over in a ditch. Calamity howlers immediately went into high gear.

Despite the fact that big guns have toppled temporarily into ditches since the Thirty Years' War, and that Hannibal had trouble with some of his elephants, a few noisy critics immediately jumped to the illogical conclusion that massive, hard-hitting cannon are a needless luxury in modern warfare.

When General Gavin said that the production of the atomic cannon had been halted, the amateur pundits prepared again to leap blindly to a similar false conclusion. The fact in this instance was that the Army is not making any more 280's because it now has, in General Gavin's words, "more improved means of delivery."

Every major war in our history has demonstrated beyond argument the need of heavy artillery. It seems to us that an all-weather atomic cannon that can deliver a devastating blow at a 20-mile range will always be a handy piece to have around on any global battlefield. Siege warfare of the future —as in the past—will be fought in bad weather as in good!

New Navy Ordnance Chief

The Bureau of Ordnance of the Navy Department bade farewell to its leader for the past four years, Rear Adm. M. F. Schoeffel, and Rear Adm. F. S. Withington became its new Chief on January 1st.

Admiral Schoeffel was appointed Chief of the Navy Bureau of Ordnance in December 1950 when he relieved Vice Adm. A. G. Noble. During his term as Chief, Admiral Schoeffel has been a stanch supporter of the American Ordnance Association and the ideals for which it stands, and through his many sound decisions has gained the complete respect of a large cross section of American industry.

> *In this era of rapid and remarkable improvements in technology, the admiral has been especially alert to keep naval ordnance up to date through his strong support of research and development. It was always his aim to concentrate on those developments that would give a maximum increase in fighting power to the Navy.*

It is understood that the admiral, after retiring on January 1st would accept a position in industry. His large circle of admirers and friends wish him the greatest success in his new career.

Admiral Withington, the new Chief of Navy Ordnance, has become well acquainted with American industry during the past year as Deputy Chief of the Bureau. He has had many years' experience in ordnance, both in the Bureau as head of the Fire Control Division, aboard ships, and as director of the Atomic Energy Division in the

Office of the Chief of Naval Operations.

The American Ordnance Association offers to Admiral Withington the full support of its membership, its Technical Committees, and its publications.

Command Post for America

Gen. Benjamin W. Chidlaw, who recently addressed the Rocky Mountain Post of the American Ordnance Association, has the combat operations center of his Continental Air Defense Command at Colorado Springs, Colo.

General Chidlaw's mission, as expressed in a 7-word directive from the Joint Chiefs of Staff, is to "defend the United States against air attack."

> *The heart of this vital operations center is a surveillance board on which is charted, minute by minute, the location and course of every unidentified airplane detected by the radar chain strung across our northern and seaward approaches.*

Identification of aircraft is a vast job, with an average of 30,000 flights a day being scheduled in the United States. Every aircraft that is unauthorized or late or off course must be identified immediately to guard against the danger that hostile airplanes may have slipped through the radar screen.

To help solve this problem, General Childlaw has set up, along the Nation's boundaries, a system of controlled flight areas. If an airplane is off schedule for any reason, the Air Defense Command sends up interceptors to have a look at it.

Communications are no less important today than men and weapons. The enemy must first be located and identified, with certitude and accuracy, before the best men and weapons in the world can repulse an attack by hostile air fleets in what may one day prove to be a battle for survival—the Battle of North America.

Ordnance Weapons Command

An Army Ordnance Weapons Command will be established at Rock Island, Ill., on January 1, 1955.

Maj. Gen. E. L. Cummings, Chief of Ordnance, said that this action provides a single field command assigned the responsibility for direction of the development, procurement, maintenance, and major aspects of supply management of many of the complex weapons systems which have become an essential part of military readiness.

> *The Weapons Command will be responsible for a wide range of small arms and artillery weapons, from the pistol and rifle through machine guns and mortars to heavy artillery such as the Army's 280-mm. atomic cannon.*

Brig. Gen. T. A. Weyher, commanding general of Rock Island Arsenal, has been selected to head the Weapons Command which, in addition to the headquarters, will include three of the country's largest, oldest, and most important old-line Ordnance arsenals—Rock Island Arsenal, Rock Island, Ill.; Watertown Arsenal, Watertown, Mass.; and Springfield Armory, Springfield, Mass.

Establishment of the new command furthers the action by Army Ordnance in setting up field responsibility for appropriate categories of Ordnance matériel. Among others are the Ordnance Ammunition Command, Joilet, Ill.; the Ordnance Tank Automotive Command, Detroit, Mich.; and the Redstone Arsenal for Guided Missiles, Huntsville, Ala.

The American Ordnance Association pledges its utmost coöperation in the implementation of these wise directives that have as their objective greater efficiency and economy in our armed forces.

Navy's New Terrier Missile

Navy continues to make rapid progress in the field of guided missiles. Successful tests have just been concluded with the Navy's new supersonic guided missile, "Terrier."

The new development—a slim, needle-nosed weapon designed to intercept aircraft at much longer ranges and higher altitudes than conventional weapons under any conditions of visibility—was demonstrated from the old converted battleship U.S.S. Mississippi during the air-defense phase of the Atlantic Fleet's largest postwar exercise, Operation Lantflex.

The Terrier is capable of being fired from either shipboard or ground stations.

> *Because of the high percentage of successful flights in the Terrier's test program, almost all launchings against target drone aircraft have been made by dummy missiles that did not carry explosive warheads. Even without warheads, the Terrier smashed several targets by direct collision.*

Hearty congratulations on another fine technical development to Admiral Schoeffel and his colleagues of the Navy Bureau of Ordnance and to American industry.

Mobilization Philosophy

In an address to the Philadelphia Chamber of Commerce, Hon. George A. Landry, Assistant Director for Production, Office of Defense Mobilization, cited the following four things that are being done to strengthen and to enlarge our mobilization base:

1. Obtaining more reliable data on our requirements in the event of stepped-up or all-out mobilization.

The Defense Department has made available estimates of what would be required in the event of all-out mobilization. They have made known schedules of 1,000 major military end items which would account for 80 per cent of the expenditures for military matériel if we should be plunged into mobilization.

Other departments of Government are providing estimates of war-supporting and rock-bottom civilian requirements.

2. Continuing to close the gaps in our mobilization base.

After the outbreak of hostilities in Korea, 233 expansion goals were established. Each goal represented a gap in our mobilization base. These goals have been largely filled, but some ninety-five remain open.

A large part of the expansion has taken place by private capital investment with the aid of rapid tax amorti-

zation. Over 19,000 tax-amortization certificates have been granted for a total expansion of about $30 billion.

Some 350 additional applications for nearly two billion dollars' worth of plant expansion are now being considered.

Stockpiles containing 75 strategic and critical materials are now valued at $4,300,000,000. Before minimum objectives are reached it will be necessary to spend another $2,500,000,000.

3. Working on the maintenance of the mobilization base.

The Department of Defense and other procurement agencies have been directed to place orders for current production, to the greatest extent possible, with firms that they have already selected as a part of the mobilization base. The Department of Defense, for example, has approximately 35,000 firms on its list of "Planned Wartime Matériel Suppliers."

Human resources are not being overlooked when it comes to placing orders for current production. Procurement officers have been directed to give special attention to production facilities in areas of labor surplus, to the extent that they can do so without paying price premiums.

The Defense Department and other procurement agencies have been directed to arrange with management to store Government-owned tools in "stand-by lines" or in "package form" at or near plants which are a part of the mobilization base and which are no longer needed for current procurement. The military departments will pay the costs of storage and maintenance which may be incurred by such a facility.

The total cost of the maintenance program will run to approximately $300,000,000 a year. It is estimated that there will be ten to twelve thousand plants in the maintenance program, and that the complete maintenance program for each individual plant will cost approximately $35,000 annually.

4. Working on the protection of our mobilization against attack.

Under the authority of the Defense Production Act, tax amortization is being used as an incentive to channel new construction to areas of less vulnerability and to encourage protective construction of vulnerable facilities.

The American Ordnance Association is keenly interested in the whole field of defense mobilization for peace and will publish a series of articles on this vitally important subject.

Waste Paper Is Waste

When do Government records become an expensive nuisance?

When they require 7½ Pentagons to house them and $4 billion a year to create and handle them.

Vast improvements have been made by various Government agencies in cutting down on paper work, but there is always room for improvement.

We are delighted to report that three expert records-handling firms are going to make a trial attack on several mountains of paper in current Government files.

> *The General Services Administration announced that, if the three firms are even moderately successful, it will ask Congress for enough money for a full-scale bonfire.*

The three contracts will cost $204,500 but the firms are convinced they will be able to save the country at least ten times that amount each year on the first trial blaze. The Senate Appropriations Committee recently estimated that a Governmentwide improvement in records handling could save at least $850 million a year.

The firms will move in on Federal records and make surveys as to what records to throw away, what records to keep in the future, and how to keep from making a lot of new records in the first place.

Eternal vigilance, we say, is also the death knell of red tape!

Modern Weapons Are Awesome

Hon. Harold E. Talbott, Secretary of the Air Force, recently declared that today's weapons "can lay waste an entire continent—men, women, children, even the beasts and the vegetation."

The United States, however, he told a Veterans' Day assembly at Arlington National Cemetery, will continue to work for world peace, so that the power of the atom will be used "not to create suffering" but to relieve it; not to destroy life "but to save it."

Addressing the Seventy-sixth National Guard Association Conference in Miami, Fla., Gen. Thomas D. White, Air Force Vice Chief of Staff, said that formidable modern weapons probably would make any future war "as short in time as it will be terrible in destruction."

He expressed the view that the outcome of such a war will be decided with the forces ready to go. There is much food for thought in both statements.

Strategic Information

A voluntary program within industry has been established to prevent the leakage of strategic information to unfriendly nations through business channels.

R. Karl Honaman, director of publications for Bell Telephone Laboratories, Inc., and exceptionally well qualified for the new post, will direct the new Office of Strategic Information.

> *The office will concern itself with scientific, engineering, and other data which, while not formerly classified as secret or confidential, might nontheless be prejudicial to our national security—if it fell into unfriendly hands.*

Such watchfulness will not take the form of censorship. It will be instead a matter of exercising intelligent, reasonable precautions to make sure that in the necessarily free exchange of scientific information we do not provide nations whose interests are hostile to our own with material which they could someday use against us.

The editors of ORDNANCE and of other A.O.A. publications are ever vigilant from this viewpoint. They heartily approve this latest prudent effort on the part of our Government to prevent the leakage of valuable information to unfriendly countries and will coöperate all the way.

Armament and World Peace

An Editorial

IT is axiomatic that the soldier who knows battle at first hand is the most ardent apostle of peace. He favors peace, not through weakness, but through strength.

General Eisenhower is a sterling example of this realistic philosophy of instant and powerful readiness to throw back any aggressive assault on our beloved country. As soldier and statesman the President has constantly sought, not appeasement, but rather resolute strength in all departments of our national-defense system that will deter any war-minded nation from the temptation to launch a sneak attack against us.

The latest strong pronouncement on this timely subject was made by the Under Secretary of the Army, Hon. John Slezak, before the Washington Post of the American Ordnance Association on November 22, 1954.

Mr. Slezak called attention to the disturbing fact that, during the past few decades, our technical knowledge has been advancing at an ever-increasing pace while our wisdom, unfortunately, has been lagging farther and farther behind.

Liking it or not, our Nation inevitably has been integrated into what is today a very small world. It is our job to find a way to live in this new atomic world so as to preserve our American way of life which has given so much to us as individuals and which is everywhere regarded as the hope of the world.

"WHAT happened after 1946," Mr. Slezak said, "is well known to all of us. However, here again we have a clear demonstration that war does not solve problems; instead it generally creates additional new problems. Force, at best, creates only temporary solutions and generally is satisfying only to the winners—and we are fast approaching the time when in such encounters there will be no winners."

The terrifying effects of nuclear weapons underline the urgent need to find a way to solve our differences by other means than by force. We must live on the same planet with other nations, and that planet has shrunk in size so much that it is increasingly difficult to destroy our enemies without, at the same time, at least partly destroying ourselves.

"There must be a better way," Mr. Slezak said. "During my lifetime, but especially during the past few years, I have traveled a great deal among the peoples of various countries of the world and invariably came home with the impression that the rank and file of all peoples do not want wars and that, by and large, their leaders prefer peace to war.

"However, in spite of the amazing advances in communications and huge increases in travel, there continues to be a tremendous amount of misinformation and misunderstanding among the peoples of the world . . . It is terrifying to hear such opinions expressed by our friends, especially when we know in our hearts that no nation is as completely dedicated to the cause of peace as we are. Obviously, we have not been telling our story from *their viewpoint* clearly and convincingly enough so that they understand and believe."

BEING convinced in the superiority of our way of life and being missionaries at heart, we frequently are anxious to share our well-being with others whether they like it or not. So it is not strange that often, instead of being admired and appreciated, we are hated. It is time that we have a look at ourselves and evaluate the consequences of our actions.

General Eisenhower and Mr. Slezak are of one mind in emphasizing the fact that, while armed strength is necessary for survival, it is not enough to hasten the day of world peace.

If people hate us, when we know that our motives are above reproach, then we must make a sincere effort, in our cities and towns across the continent, to understand people of other nations—their history, tribulations, and aspirations. If we really do not understand other people in their own cultural and physical environments, we will continue to have our most altruistic actions misinterpreted and misunderstood.

In like fashion we should hope that people in other lands will soon gain in a genuine understanding of us—people of every race, religion, and nationality who have come to our shores from the four corners of the earth.

Unless other people understand how we feel, then how can we expect them to believe that we can be truly unselfish, truly altruistic?

Let us be strong. But let us not be strong only in material things—tanks, guns, airplanes, and ships. Let us be strong also in things of the spirit while keeping our powder dry!

We want progress. We want to use our technical know-how to raise the standards of people in other lands—their spiritual standards, their intellectual standards, their capacity for happiness on this earth. In doing so, we raise the standards of the world. And only as we keep on doing that—through individual rather than public effort—can we look forward to a new era of lasting and permanent peace.

This is the Eisenhower-Slezak doctrine of mutual understanding among the nations of the world. It is a doctrine to which all good citizens will subscribe without reservations of any kind. Certainly it is the basic philosophy which has guided the American Ordnance Association for thirty-five years. Upon its sensible application in days to come depends our own peace and the peace of the world.

Air Power for Security

A report of the Thirty-sixth Annual Industrial Preparedness Dinner Meeting of the A.O.A. and the Seminar on Guided Missiles, together with the Council and Board of Directors' meetings held in New York

GEN. NATHAN F. TWINING, Chief of Staff, United States Air Force, and guided missiles were the glittering high points of the Thirty-sixth Annual Industrial Preparedness Meeting of the American Ordnance Association held at the Waldorf-Astoria Hotel in New York on Wednesday, December 1, 1954.

For the afternoon meeting a great crowd—closer to 1,000 than to 900—turned out for the Seminar on Guided Missiles at the Starlight Roof of the Waldorf. Louis Polk, vice-president of the A.O.A. in charge of Technical Divisions and Committees and president of the Sheffield Corporation, Dayton, Ohio, chairman of the seminar, introduced Hon. Donald A. Quarles, Assistant Secretary of Defense (Research and Development), the moderator.

Secretary Quarles opened the meeting by introducing the three guests of honor at the speakers' table: Frank B. Newbury, Assistant Secretary of Defense (Applications Engineering) and chairman of the Guided Missiles Program Survey Committee; K. T. Keller, former Director of Guided Missiles, United States Department of Defense and chairman of the board, Chrysler Corporation; C. L. Eksergian, chairman, Guided Missile, Rocket and Jato Division, American Ordnance Association, and executive engineer, the Budd Company.

Each service presented its story of guided-missile development through the following officers: for the Army, Maj. Gen. L. E. Simon, chief, Research and Development Division, Office of the Chief of Ordnance; for the Navy, Rear Adm. J. H. Sides, director, Guided Missiles Division, Office, Chief of Naval Operations; for the Air Force, Brig. Gen. J. S. Kelsey, director, Research and Development, Office of the Deputy Chief of Staff, Development.

The full report of all four talks will appear in an A.O.A. brochure for early distribution to members.

Lieut. Gen. Levin H. Campbell, Jr., in his last public appearance as president of the Association, was toastmaster for the dinner meeting at which Maj. Gen. R. L. Maxwell, president of the New York Post and vice-president of American Machine & Foundry Company, presided. Two thousand one hundred and ten members and guests were present.

The guest of honor, General Twining, was presented with the Levin H. Campbell Gold Medal for distinguished service to the national defense by Mr. Keller, a senior director of the American Ordnance Association. After the presentation, General Twining addressed the assembly on progress in air power. His address is published in full on page 546 of this issue.

As soon as the members and guests were seated in the grand ballroom, Brig. Gen. Henry Darlington, U.S.A.F. (Ret.), president of the Military Chaplains' Association, delivered an appropriate invocation followed by the National Anthem.

General Maxwell opened the meeting with a message of welcome and then turned the proceedings over to

IBM

Under Secretary of the Army John Slezak, left, chats with Gen. Nathan F. Twining, Air Force Chief of Staff, and S. C. Hope, new A.O.A. vice-president.

IBM

Left to right: J. G. Phillips, chairman, New York Committee; Lieut. Gen. L. H. Campbell, retiring A.O.A. president; General Twining, guest of honor; Lieut. Gen. L. R. Groves, Remington Rand Inc.; Vice Adm. G. F. Hussey, Jr., A.O.A. president-elect.

General Campbell who gave a stirring talk on the ideals and the bright future of the American Ordnance Association. General Campbell then introduced Vice Adm. George F. Hussey, Jr., managing director of the American Standards Association, the president-elect of the American Ordnance Association, and Brig. Gen. Charles A. Lindbergh, a special guest of honor. Upon the introduction of General Lindbergh, the crowd rose to its feet with a spontaneous and thunderous burst of applause.

Mr. Keller read the following citation for the guest of honor:

"General Twining, Chief of Staff, United States Air Force, has exerted a broad and effective influence on the development of air power as an element of the national defense of the United States.

"In the Pacific, in Italy, in Alaska, and at other posts of great responsibility, General Twining directed the utilization of American air armament to its maximum extent for victory in war.

As director of the Air Matériel Command he further coördinated the scientific and industrial aspects of air armament with the engineering and production facilities of the United States for the maintenance of peace.

"The American Ordnance Association confers upon General Twining with expressions of appreciation its gold medal named in honor of Lieut. Gen. Levin H. Campbell, Chief of Ordnance, United States Army, 1942-1946, and president of the Association, 1953-1955."

General Twining responded, expressing his appreciation for the honor bestowed upon him.

Great credit for the success of this gathering, the largest dinner meeting in the annals of the Association, is due the New York Post Committee. This committee was comprised of the officers and directors of the Post under the leadership of General Maxwell. Included were J. L. Auer, Admiral Hussey, Henry T. Luria, J. G. Phillips, Col. J. W. Graham, George W. Allison, Nelson Anderson, Paul T. Cullen, William E. Eisner, Arnold Erlanger, William R. Janney, D. Blair MacMaster, Chester Mueller, Henry N. Sachs, Lloyd W. Stearns, A. E. Van Cleve, and Gordon B. Welch.

The following comprised the special committee of the Post: Hartley W. Barclay, Rear Adm. R. T. Cowdrey, Brig. Gen. John Ross Delafield, Crosby Field, R. E. Gillmor, J. M. Gruitch, Arnold W. Hanger, Stanley C. Hope, G. O. Kuhlke, E. F. McCrossin, Brig. Gen. Willis R. Slaughter, Thomas O. Woolf, and V. J. Zaro.

THE general meetings were preceded by the Annual Directors' Meeting of the American Ordnance Association where the highlight was the election of Admiral Hussey as the next president of the Association to take office on January 1, 1955.

The directors met at the University Club in New York City on the morning of December 1, 1954, with General Campbell presiding. The following directors and officers were present: Donald F. Carpenter, Wilmington, Del.; C. Stewart Comeaux, Oklawaha, Fla.; R. E. Gillmor, New York, N.Y.; Stanley C. Hope, New York, N.Y.; George F. Hussey, Jr., New York, N.Y.; C. Jared Ingersoll, Philadelphia, Pa.; K. T. Keller, Detroit, Mich.; Frederick H. Payne, Springfield, Mass.; John Slezak, Sycamore, Ill.; Herbert A. Gidney, Pittsburgh, Pa.; Harvey C. Knowles, Cincinnati, Ohio; Louis Polk, Dayton, Ohio; Robert L. Biggers, Detroit, Mich.; John S. Pfeil, Boston, Mass.; Daniel J. Martin, Houston, Tex.; John M. Olin, New York, N.Y.; William J. Rushton, Birmingham, Ala.; John Ross Delafield, New York, N.Y.; John F. Floberg, Washington, D.C.; Leo A. Codd, Washington, D.C.; and Florence G. Ferriter, Washington, D.C.

Present from the national headquarters staff in Washington, D.C., were Roger E. Lewis, Brig. Gen. Burton O. Lewis, Brig. Gen. Thomas K. Vincent, Capt. J. M. P. Wright, and R. J. Warfel.

General Campbell welcomed Mr. Floberg, former Assistant Secretary of the Navy for Air, as assistant counsel of the Association, and General Vincent as a member of the staff of national

headquarters. Colonel Codd, executive vice-president, assisted by members of the headquarters staff, presented reports of operations for the first eight months of 1954.

The chairman of the Nominating Committee, Mr. Gillmor, who was assisted by W. J. Rushton, Birmingham, and Britton L. Gordon, Grand Rapids, reported, in addition to the nomination of Admiral Hussey as president for the two years beginning January 1, 1955, the nomination of Stanley C. Hope, president of Esso Standard Oil Company, to be a vice-president replacing Herbert A. Gidney, who remains as a national director. Both were unanimously elected.

In congratulating Admiral Hussey, General Campbell said he felt strongly that a 2-year tenure of office was in the best interests of the Association and that he had refused nomination for a second term as he believed that the presidency should be rotated among men connected with the three services and with industry to make the broad interest of this Association apparent at the top level.

Admiral Hussey has been managing director and secretary of the American Standards Association since 1948, shortly after he retired from the Navy upon completion of four years as Chief of the Navy's Bureau of Ordnance. In managing the American Standards Association—a federation of technical societies and trade associations serving as the national clearinghouse for standards—the admiral has maintained close contact with all phases of United States industry.

He was commissioned ensign upon graduation from the U. S. Naval Academy in 1916 and, after a sea tour, completed a postgraduate course in ordnance engineering in 1923. He served at sea in battleships and destroyers and ashore in ordnance billets at the Bureau and the Naval Proving Ground, Dahlgren, Va., and in the early days of the war commanded Destroyer Division 24 and Mine Squadron 3. In December 1942 he reported to the Bureau of Ordnance, serving in several positions before being appointed Chief.

He received the Distinguished Service Medal and the Order of the British Empire, Honorary Commander, Military Division.

Admiral Hussey has been a member of the A.O.A. for many years and was president of the New York Post, 1950-1954. He was president of the U. S. Naval Academy Alumni Association in 1953; vice-president, 1950-1951; and trustee, 1952-1953.

The executive vice-president proposed that Colonel Payne, former Assistant Secretary of War, who has completed eight years on the Board of Directors, be made a member emeritus of the Board. This was heartily acclaimed by the members, and it was also voted that the following members whose terms had expired would be made members of the Advisory Board: Fairman B. Lee, Seattle; Myron J. Hayes, Rochester; E. R. Godfrey, Detroit; and John Slezak, Sycamore, Ill.

At the request of the chairman, Mr. Polk read a citation in recognition of the splendid service performed by Brig. Gen. Burton O. Lewis during his many years at national headquarters as consultant for Technical Divisions and Committees.

The citation recited General Lewis's distinguished career from the time of his graduation from the U.S. Military Academy in 1910 until his retirement in 1947 during which he served overseas in World War I and in many Ordnance billets. The citation concluded:

"GENERAL Lewis holds the Distinguished Service Medal, the Purple Heart, and the Legion of Merit from the United States Government, as well as decorations from both the British and French Governments. His work for our Technical Divisions and Committees has made their reputation one of universal acclaim. We shall count upon having his counsel and guidance always.

"In conferring the John H. Rice Gold Medal upon him we are associating his name with one of his early commanders under whom he served in the Ordnance Department of the Army in this country and abroad. The joining of these two names links for all times the careers of two great Ordnance officers."

The Rice Medal will be bestowed upon General Lewis at a special gathering in Washington early in 1955.

The Board of Directors' meeting was followed by a luncheon meeting of the National Council of the Association with General Campbell presiding. After lunch, C. K. Davis, vice-chairman of the Council, reported briefly on the year's activities.

He was followed by Mr. Gillmor who announced the nomination and election by letter ballot of Council of the following directors: B. F. Fairless, U. S. Steel Corporation, Pittsburgh; Mr. Hope; S. E. Skinner, General Motors Corporation, Detroit; Henry N. Marsh, Hercules Powder Company, Wilmington; and Paul L. Davies, Food Machinery & Chemical Corporation, San Jose, Calif.

This report was followed by that of the chairman of the nominating committee for Council members at large, Col. Ludlow King, who was assisted by R. C. Geffs, Los Angeles, and Harry S. Robinson, Cincinnati.

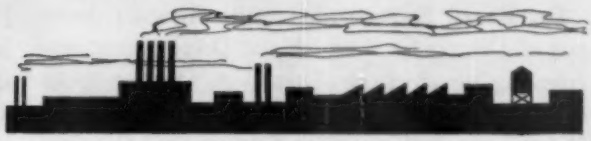
The twenty-four members at large of Council for 1955 will be: Joseph L. Auer, New York; Maj. Gen. G. M. Barnes, Washington, D.C.; John S. Begley, Springfield, Mass.; F. W. Conant, Santa Monica, Calif.; C. K. Davis, Bridgeport, Conn.; Irving A. Duffy, Detroit; E. B. English, Peoria; Robert C. Enos, Corapolis, Pa.; Britton L. Gordon, Grand Rapids, Mich.; G. M. Greenwood, Richmond, Calif.; John M. Hancock, New York; Arnold Hanger, New York; Walter N. Howley, Morton, Pa.; Roy T. Hurley, Wood-Ridge, N.J.; Maj. Gen. R. L. Maxwell, New York; John C. McHannan, Cleveland; William H. Mitchell, Cincinnati; Thomas E. Murray, Washington, D.C.; Walter C. Pew, Philadelphia; Henry J. Sullivan, Detroit; J. Carlton Ward, Jr., New York; Thomas J. Watson, New York; Herbert R. White, Detroit; and W. A. Wilson, Los Angeles.

THE guest of honor at the luncheon, Under Secretary of the Army John Slezak, closed the session with an informal talk about some of his interesting experiences while visiting Army establishments abroad.

Reg. U. S. Pat. Off.

INDUSTRIAL PREPAREDNESS

a monthly report on current scientific and logistical developments as they relate to our armament preparedness



This bulletin appears regularly in ORDNANCE. In the months in which the magazine is not published this bulletin is mailed directly to the members of the Technical Divisions and Committees of the Association

No. 99 January 1955

● **The Fire Control Instrument Division** of the A.O.A. met on November 10, 1954, at the Naval Ordnance Laboratory, White Oak, Md. Approximately one hundred members of the Committee and guests were present. The arrangements were handled by the Division chairman, Col. R. L. Goetzenberger, and with the aid of Deputy Chairman P. R. Bassett, General Chairman Henry N. Marsh, and Staff Consultant Brig. Gen. Burton O. Lewis from A.O.A. National Headquarters, a most interesting and successful program was presented.

After a brief welcome by the very busy commander of the Laboratory, Capt. J. T. Hayward, U.S.N., Donald E. Marlowe, associate director of engineering at N.O.L., gave a short account of the establishment of the Naval Ordnance Laboratory and its genesis from the old Naval Fuze Laboratory, a section of the Naval Gun Factory.

General Lewis brought greetings from National Headquarters and enlarged on the aim of the A.O.A. to have every member of every Committee cleared through "Secret" on a national basis. Due to the large backlog of clearance requests in the Department of Defense, these clearances are slow in coming but are well worth the delays.

Colonel Goetzenberger outlined the agenda for the conference. He commented, "While we cannot hope to approach the solution of any specific problem today, we trust that exposure to them may inspire recommendations through the normal channels of your Committee activity. If we can stimulate a penetrating interest, even though some presentations may be general in scope, then we will have set in motion the Industry-Ordnance Team toward the attainment of the goals of our Association."

The Hon. Frank H. Higgins, Assistant Secretary of the Army, Logistics, Research, and Development, was most emphatic in placing A.O.A. and its industry advisers and Committees on the country's security team. He mentioned the four missiles—Nike, Honest John, Corporal, and Redstone—which have been turned over to industry for production. He discussed the changed organization of topside of the Army and the installation of financial accounting procedures for property owned by the Army.

Business methods and dollar-consciousness in spending $10.2 billions in the continental United States for the Army this year points to an appreciation, at long last, of the taxpayers' interest in how these appropriations are handled. The inventory of Army property, including real property, is estimated to be $45 billion and is big business under any definition.

Colonel Higgins' emphasis on the Department of Defense objective to get the Government out of every activity that could be done by civilian industry was received most favorably by those present.

A new thought on research and development was expressed. We, as a nation, by our Constitution and ethics are handicapped in learning about the other fellow. Therefore we are confronted in research with the impossible job of experimenting in all directions and in all fields. This is very expensive and if pursued to the ultimate would bankrupt the Nation. Therefore our research and development activities are geared to the size of our defensive forces and are as large as practicable. We cannot take on any more at this time, regardless of need or desire.

Logistics, which is only one of Colonel Higgins' responsibilities, is of great concern to the Depart-

ment of the Army. It recognizes that another war will not permit the habitual 2-year "get-ready" period but will start with little warning. Our logistical setup must be realistic and adequate at all times to meet this contingency.

Dr. Daniel P. Barnard, Deputy Assistant Secretary of Defense for Research and Development, representing his chief, Dr. Donald A. Quarles, spoke briefly on the organization of the Department of Defense and the separation of managerial functions from technical activities.

Comdr. R. K. Irvine, chief, Fire Control Branch, Research and Development, Bureau of Ordnance, spoke on the transition in developing fire control from the field of conventional weapons to guided missiles. The problems of underwater missile systems, the increasing complexity of fire-control gear, and the inability of enlisted technicians to handle these complicated mechanisms in the field are terrific operational and maintenance problems which must be solved by the services themselves. Scientists are not available, nor could they be used in combat, to maintain this complicated equipment.

Comdr. V. P. Healey, Fire Control Branch, Material Division, Navy Bureau of Ordnance, repeated the three basic, servicewide requirements for fire-control systems—reliability, maintainability, and producibility. These are made more difficult to meet by the introduction of increasingly complicated electronic gear, poor reënlistment experience in the case of trained technicians, and the constantly increasing expense of production.

Col. H. D. Hiester, chief, Artillery Branch, Research and Development Division, Office of the Chief of Army Ordnance, spoke of the Industry-Ordnance teamwork and the reliance placed by the Ordnance Corps on the A.O.A. Divisions and Committees to solve acute fire-control problems.

He discussed trajectory instrumentation, defined as the location of an object in space in real time, and target synthesization, whereby we may have something of a nondestructive character that can be converted into analogue data the better to serve as a test medium.

Dr. Gilbert Cain of Frankford Arsenal illustrated by slides several problems in fire-control and optical-system design that had been solved by the arsenal. He presented problems in the optical field, including the need for better dry film lubricants, low-temperature-resistant rubber, reproducible standards for striae in optical glass, and statistical quality control and classification of defects in optics. He gave a brief progress report on prior problems.

Maj. Gen. J. L. Holman, commanding Aberdeen Proving Ground, introduced R. P. Witt, chief of the Laboratory Service Division at Aberdeen. His problems were familiar ones and included the need for a method of dynamic testing of crusher gages, standardized arms to be used as calibrated test instruments, and higher speed cameras.

Col. Paul S. Bechtel, U.S.A.F., representing Brig. Gen. E. P. Mechling, commandant of the Air Force Armament Center, Eglin Air Force Base, spoke of that facility and its mission of engineering evaluation of weapons and weapons systems used by the Air Force.

Hugh C. Carroll, chairman of the A.O.A. Proving Ground Instrumentation Committee, reporting for this Committee, stressed the need for broadening the procurement field for instrumentation to the larger industrial producers. The small producers are doing a good job, but other and larger sources must be developed. He announced a symposium to be conducted for his Committee in March at Patrick Air Force Base, Fla.

F. E. Ericson, chairman of the A.O.A. Instrument Precision Ball Bearings Committee, paid high tribute to the members of his Committee for the unselfish way in which they gave of their time and talents to Committee work. He quoted the published objectives of the American Ordnance Association and stated that "there was no other national group so unselfishly interested in the security and defense of our country."

Torque and its measurement, bearing vibrations, and standardization are now under consideration by the Committee. Production has been increased in a number of ball-bearing facilities as a result of the Committee's efforts.

William M. Brandes, chairman of the Instrument Jewel Bearings Committee, reported on his Committee. Jewel bearings are still a major problem in our economy. The existing national stockpile is obsolete, due to improved jewel setting techniques.

The facility established by a national manufacturer in North Dakota, using Indian personnel, who have a long history of jewel finishing, has resulted in increasing the output of acceptable jewel bearings and has added a needed facility to the small number already in this country. The acute problem of this Com-

mittee is the development of higher speed drilling machines with smaller diameter capacities.

A fine lunch in the N.O.L. cafeteria and a guided tour of several of the Laboratory facilities completed the meeting. It was a most interesting day in which the Committee members and guests acquired a timely report on this important Division's activities. It was held under perfect conditions, due to the hospitality and coöperation of Captain Hayward and his staff and the able leadership of Colonel Goetzenberger and his Committee chairmen and members. A salute to all from national headquarters!

● **Washington observers believe that Contract Renegotiation** will expire with the passing of the old year. The Congress is not expected to renew it further, but the cleanup will take another two years.

● **The Army has contracted** for nearly a billion dollars' worth of heavy items during the first quarter of fiscal 1955. These include $161,000,000 to Chrysler for M48 medium tanks, $64,000,000 to Sikorski for helicopters, $200,000,000 to Western Electric for guided missiles and equipment, $26,500,000 to Food Machinery and Chemical Corporation for M59 armored infantry vehicles, $35,000,000 to General Motors for M42 self-propelled twin 40-mm. antiaircraft guns, $24,000,000 to Western Electric for fire-control systems, and $17,000,000 each to Sperry and AC Spark Plug for fire-control systems.

● **The Government will soon operate** two machine-tool stockpile programs. The Defense Department, with an appropriation of $100,000,000 which expires next June, plans to buy "long-lead-time" machine tools that take months to make. The Office of Defense Mobilization plans to buy $40,000,000 worth of "elephant" machine tools—those that are used to make other and larger machine tools.

● **The National Chamber of Commerce** has issued a 60-page booklet entitled "Contract Termination Guide," which seems to be the only interpretation of current settlement procedures available to manufacturers. It carefully takes the user through the maze of technicalities and inconsistencies of contract termination settlement. The price is $1.00 each with discounts on bulk lots. Write to Manufacture Department, U.S. Chamber of Commerce, 1615 H Street N.W., Washington, D.C.

● **An editorial** by Joseph V. Moreschi, president of the Hod Carriers' Union, referring to the Declaration of Independence in the union's magazine, writes:

"Our forefathers fought for and declared their intention that it is the inalienable right of men to have life, liberty, and the pursuit of happiness. These words 'life, liberty, and the pursuit of happiness' were more than an eloquent passage in that great document. These words were the touchstone of a new nation, and they framed an ideal which we still seek. We still must work and fight for life and liberty in these troubled times, and we still must work unremittingly if we are to enjoy the pursuit of happiness."

Sort of puts it squarely that these "rights" are also "responsibilities."

● **Hydrazine,** one of the simplest hydrides of nitrogen, was first isolated by Curtius in 1887 and remained a chemical curiosity for more than fifty years. It was used in World War II by the Germans as a rocket and jet fuel, and then ordnance, industrial, and academic laboratories became interested.

Hydrazine is a hydronitrogen, and the fact that it is a combustible comes as a surprise. It makes a fine speciality fuel since it boils at 114 degrees and freezes at 2 degrees Centigrade. Its density is 1.01 grams per cubic centimeter which means more can be packed in a given volume. It is packaged energy, and can be handled, stored, and shipped without difficulty. It has a few disadvantages, such as being slightly toxic, which are far outweighed by its advantages. We shall hear more about this hydride of nitrogen.

● **The report of the Cooper Committee** entitled "Financial Management in the Department of Defense," after thirteen months of work by the committee headed by Charles P. Cooper, retired vice-president of A.T.&T., makes ten major recommendations:

1. Initiation of an aggressive continuing program for the selection, training, and development of more

MEETINGS OF NATIONAL TECHNICAL DIVISIONS AND COMMITTEES OF THE AMERICAN ORDNANCE ASSOCIATION

- **The Fuze Committee of the Bomb and Artillery Ammunition Division met at Chicago, Ill., on Wednesday, December 15, 1954.**
- **The Instrument Precision Ball Bearings Committee of the Fire Control Instrument Division met at the Engineers Club, New York City, December 8, 1954.**
- **The Dimensional Standards and Metrology Division will meet at the U.S. Naval Shipyard, Brooklyn, N.Y., on Wednesday, January 12, 1955.**
- **The Rocket, the Jato, and the Development and Material Committees of the Guided Missile, Rocket and Jato Division will meet at the plant of the Tube Reducing Corporation, Wallington, N.J., during January 1955.**
- **The Surface Preservation Committee of the Advisory Technical and Research Group will meet at Los Angeles, Calif., on Tuesday and Wednesday, February 8 and 9, 1955.**
- **The Cartridge Case Committee of the Bomb and Artillery Ammunition Division will meet at Los Angeles, Calif., during February 1955.**
- **The Underwater Ordnance Division will meet at the U.S. Naval Base, Key West, Fla., during March 1955.**
- **The Proving Ground Instrumentation Committee of the Fire Control Instrument Division, will meet at Patrick Air Force Base, Fla., in March 1955.**
- **The Small Arms and Small Arms Ammunition Division will meet at the Springfield Armory, Springfield, Mass., early in April 1955.**
- **The Bomb and Artillery Ammunition Division will meet at Shreveport, La., the second week in April 1955.**
- **The Loading Committee of the Bomb and Artillery Ammunition Division will meet at Milan, Tenn., the third week in April 1955.**

competent civilian and military personnel for assignment to financial management duties.

2. Realignment of all appropriations into five significant categories, with the boundaries of each category clearly defined in order that useful comparisons can be made.

3. Closer and more realistic coördination of military planning and budget programming on a continuous basis.

4. Preparation of all budgets on the basis of actual costs of the work to be performed during the budget year.

5. Simplification of the form of preservation of the budget.

6. Rigid adherence to a time schedule in budget preparation, with no estimating to commence more than twelve months before the beginning of the budget year.

7. Greater use of revolving funds, such as stock and industrial funds.

8. Installation of an accounting system of the double-entry accrual type.

9. Employment of depreciation accounting with respect to (a) industrial and commercial activities, including commercial-type transport facilities, and (b) construction equipment and other facilities consumed in the process of construction.

10. Development of a well-rounded audit program, suitable for a decentralized pattern of operations such as the services must conduct, including an independent audit of procurement operations.

Previous studies of subjects under review were reexamined, viewpoints of outstanding leaders were obtained, and additional research was conducted.

The result is a final report which sets forth the basic principles subscribed to by the committee and which business should earnestly support. If put into effect it could save many millions of dollars.

● **The army is realistic** when it comes to costs. The cost of storage space, when balanced against improbable need for much that is surplus equipment, results in an apparent loss of capital investment when the return from surplus sales is ten cents on the dollar. Equipment worth $1.5 billions has been turned up as surplus; some of it can be used currently by the services, but the bulk of it goes on the block. Seventeen depots will be closed and operating costs reduced by $30 million. Nineteen million square feet of covered storage space will be released.

● **A pattern of things to come** may be forecast by the "atomic-bomb-resistant" laboratory recently completed for the Armed Forces Institute of Pathology at Walter Reed Medical Center. The windowless wall facing downtown Washington is heavier than the other walls, and it is estimated that a direct hit on downton Washington will not disturb the structural part of the building.

ASSOCIATION AFFAIRS

Louisiana Post Plans To Transfer Its Headquarters to Shreveport

The Louisiana Post held a special meeting at the Shreveport Club, on November 22nd to reorganize the Post headquarters incident to transferring from New Orleans to Shreveport.

For the past year there has been an extremely active chapter in New Orleans, but due to the greater number of industries and over-all membership in the northern part of the State it was decided to transfer the headquarters to Shreveport.

Over eighty members were on hand to elect officers and directors and make plans for a regular meeting.

All industries in the area were represented including Texarkana and Marshall, Tex. Members from the latter two cities recommended strongly that their area be added to the Louisiana Post area, and it was agreed to present this proposal to National Headquarters.

The new slate of officers agreed upon was James A. Ward, of Remington Rand Inc., Post president; Willard L. Love, Rheem Manufacturing Company, New Orleans, second vice-president; and H. E. Evans, Remington Rand Inc., Shreveport, secretary.

The following directors also were elected: R. L. Telford, Silas Mason Corporation, Shreveport; Ernest A. Merklein, Merklein & Company, Shreveport; J. G. O'Brien, J. B. Beaird Company, Shreveport; T. D. Hoskins, Louisiana Light & Power Company, New Orleans; C. L. Bernard, General Motors Corporation, New Orleans; and C. L. Brockschmidt, Texas Eastern Corporation, Shreveport.

A first and third vice-president and six more directors will be elected when a decision is forthcoming on adding Marshall and Texarkana to the Louisiana Post area.

In attendance at the meeting were the commanding officers of Red River Arsenal, Texarkana; Longhorn Ordnance Works, Marshall; Lone Star Ordnance Plant, Texarkana; and Louisiana Ordnance Plant, Shreveport.

With the backing of these Ordnance facilities and the many industries, the Louisiana Post expects soon to enjoy a healthy increase in membership.

The members made plans to hold an annual meeting in connection with the annual meeting of the A.O.A.'s Bomb and Artillery Ammunition Division in April in the Shreveport area.

Midwest Post Hears Guided Missile Experts at Seminar and Dinner

The Midwest Post staged a gala program on November 12th under the masterful leadership of Post President Harry Darby, head of the Darby Company. Activities started with a luncheon at the Muehlebach Hotel where Mr. Darby was host to the guest of honor, Brig. Gen. W. L. Bell, commanding general, White Sands Proving Ground, and many distinguished citizens of Kansas City. General Bell regaled the party with anecdotes of life at White Sands and some of his problems in missile testing.

During the afternoon program a surprisingly large number of members attended the seminar on guided missiles and defense procurement problems.

Mr. Darby introduced Elmer Pierson, chairman of Vendo Company and a Post director, who was chairman for the session. He was assisted by the following panel: Col. Miles B. Chatfield, director of the Missiles Laboratories at Redstone Arsenal; Allan Chilton, Westinghouse Electric Corporation; W. B. Paine, Bendix Aviation Corporation; J. E. Midgarden, Sunflower Ordnance Plant, Hercules Powder Company; and Martin Goland, Midwest Research Institute.

General Bell predicted that guided-missile production would be accelerated, pointing out that production of the Nike missile systems so far had required over 1,000 subcontractors and that industries in Kansas and Missouri probably were manufacturing some parts, unaware that they were to be used in missiles.

Colonel Chatfield said that the increasing accuracy of defense missiles indicated deadly accuracy would be obtainable against hostile aircraft. He estimated that, in the future, missiles would replace aircraft in many combat operations and then described briefly the purpose of four missiles represented by small scale models on display at the meeting: Hermes, Nike, Corporal, and Honest John.

Among local industry exhibits were a Westinghouse turbojet engine, metal parts and auxiliary devices from the Vendo Company, and a display showing the processing of caliber .50 cartridges from Remington Arms Company.

The evening session was a sparkling affair at which over 400 members, guests, and their ladies gathered for a reception and dinner in the grand ballroom of the Muehlebach Hotel. Among the dignitaries present were Governor Edward Arn of Kansas and Congressmen Scrivener of Kansas and Bolling of Missouri.

When all guests were assembled in the banquet room a brief invocation was delivered followed by "God Bless America" sung by the entire gathering. After dinner and the introduction of the many distinguished guests Mr. Darby introduced Colonel Chatfield who told in general terms of the problems that face the guided-missile development engineers.

Capt. J. M. P. Wright, of A.O.A. Headquarters, outlined recent activities and described the importance of membership in the A.O.A.

After a glowing introduction by Mr. Darby, General Bell delivered the major talk of the evening, describing the physical aspects and operations of White Sands Proving Ground.

• **AT WASHINGTON.**—The Washington Post held its first monthly luncheon meeting of the 1954-1955 season at the National Press Club on Monday, November 22, 1954. The members this year

plan to invite speakers to discuss world affairs, particularly as they affect the national defense of the United States.

The Post was most fortunate to have Under Secretary of the Army John Slezak as the first speaker to start this well-conceived program. The Secretary had recently inspected many Army establishments in Europe, and his information was right up to the minute.

The meeting was called to order promptly by George M. Riveire of Goodyear Tire & Rubber Company, the Post president. He first introduced the guests at the speakers' table who were, in addition to the officers and directors of the Post, Brig. Gen. Donald Armstrong, a member of the Advisory Board of the A.O.A.; Hon. Frank H. Higgins, Assistant Secretary of the Army (Logistics, Research, and Development); Maj. Gen. J. K. Christmas, a former president of the Washington Post and now with Barium Steel Corporation; and J. M. Linforth, vice-president, Goodyear Tire & Rubber Company. Rear Adm. M. F. Schoeffel, Chief of the Navy's Bureau of Ordnance, also was introduced.

Secretary of Defense Wilson Receives Crowell Medal at Cleveland Meeting

Hon. Charles E. Wilson, Secretary of Defense, was awarded the Association's Benedict Crowell Gold Medal for distinguished service at an historic meeting of the Cleveland Post held at Hotel Statler, Cleveland, on November 11, 1954. Seven hundred members and guests were in attendance.

The medal, awarded by the Cleveland Post, is one of the highest awards of the Association and commemorates the outstanding patriotism of a founder of the Association, Brig. Gen. Benedict Crowell, who was Assistant Secretary of War and Director of Munitions during the First World War.

Secretary Wilson, in an address following the presentation, spoke informally on some of the principal problems facing the military establishment during the coming year. He stressed the importance of military career manpower and the need for improved training and personnel advantages. He urged an extension of the Selective Service Act with improvement in many details. He stressed the need for the maintenance of a pool of trained technical Reserve officers and, above all, the maintenance of combat effectiveness by all services.

The presiding officer at the meeting was Albert J. Weatherhead, Jr., president of the Post and president of the Weatherhead Company of Cleveland. In sounding the keynote of the meeting, Mr. Weatherhead emphasized the important rôle of the Industry-Ordnance Team and urged its members in the Cleveland area to renewed devotion to this important ideal.

The presentation of the Crowell Medal to Secretary Wilson was made by Charles M. White, a director of the Post and president of Republic Steel Corporation.

A resolution was presented by Mr. Weatherhead on behalf of the Cleveland Post, pledging the Post's coöperation for civil defense to John J. Pokorny, Civil Defense Coördinator, Cuyahoga County.

Col. Leo A. Codd, executive vice-president of the Association also addressed the meeting on the Science-Industry-Ordnance Team.

Key figures at Cleveland Post dinner were, left to right: A. J. Weatherhead, Jr., president; Col. S. W. Connelly, deputy district chief; Defense Secretary Charles E. Wilson; Charles M. White, a director of the Post. Mr. Wilson received the Crowell Medal.

• **AT BREMERTON.**—The Puget Sound Post enjoyed an active day with the Navy on November 20th when it visited the Naval Ammunition Depot, Bangor, Wash., and the Naval Shipyard at Bremerton, Wash.

Under the leadership of Post President C. Walter Huffine, a group of 125 members and guests boarded the U.S.S. CHARLES E. BRANNON, Destroyer Escort 446, at an early hour. There was a great deal of interest in the operation of the DE, and the members were very graciously received by Comdr. W. E. Dean, the "Skipper." Three hours later the party was greeted at the Bangor Ammunition Depot by Capt. Bruce D. Kelly, commanding officer, prior to an inspection trip of the facilities of the depot.

From there the members were transported by bus to the Officers' Club at Bremerton where luncheon was served and a meeting was held. The toastmaster was Lieut. Michael E. Conway, commanding officer of the Naval Ordnance Reserve Company, Seattle.

Speakers were Comdr. Oliver Compton, Bremerton Shipyard Ordnance Officer, who outlined some of the interesting features of armament activities, and Comdr. J. A. S. O'Handley, Ordnance Officer for the 13th Naval District, who spoke on the activities of the Navy Ordnance Reserve. The background and the purpose of the American Ordnance Association were discussed by President Huffine.

After luncheon the members were treated to a tour of the U.S.S. INDIANA and the U.S.S. MISSOURI. The BRANNON was on hand at 3 p.m. to transport the party back to Seattle.

• **AT CHICAGO.**—The annual luncheon meeting of the Chicago Post on November 15, 1954, attracted a crowd of almost 500 A.O.A. members who packed the Williford Ballroom of the Conrad Hilton Hotel, Chicago, to hear about procurement prospects from representatives of the Army, Navy, and Air Force.

Post President Thomas Drever, president of American Steel Foundries, brought the meeting into action promptly, introducing Capt. J. M. P. Wright of A.O.A. Headquarters who reported on present major activities and explained the importance of membership in the A.O.A.

Capt. Harold S. Harnly, commanding officer, Naval Ammunition Depot, Crane, Ind., outlined the Navy Bureau of Ordnance prospects in general, reported on expected expenditures by naval ordnance plants in the area, and discussed some of the mutual inspection problems of industry and Navy ordnance.

Col. Robert L. Finkenstaedt, area Air Force procurement officer, followed with interesting features of procurement outlook in his service.

The chief of the Chicago Army Ordnance District, Col. Lyman F. Stangel, predicted that fifteen per cent of Army Ordnance funds would be spent in the area plus a good percentage of the subcontracting from the tank program—or an estimated $200 million.

• **AT BOSTON.**—With its annual meeting on November 3rd the Yankee Post initiated the first of a series of programs dealing with the capabilities of the United States and its allies under present world conditions.

A reception and dinner meeting were held in the Museum of Science where the audience was treated to an exhibit of the museum's ingenious scientific devices and a demonstration featuring some of the scientific apparatus utilized in exploring nuclear reactions and in improving jet propulsion.

The meeting was called to order by Post President Helge Holst, treasurer, A. D. Little Company. The principal order of business was the election of officers in which the slate of the nominating committee was unanimously elected.

Charles B. Weeks, treasurer, Hesse-Eastern Corporation, was elected president for the coming year. Other changes appear in the 1955 Annual Directory included as Section II of this issue.

The new president was duly installed and as chairman introduced the principal speaker of the evening, Rear Adm. John D. Hayes, president of the American Military Institute and for several years a member of the faculty and staff of the Industrial College of the Armed Forces.

• **AT BINGHAMTON.**—The Tri-Cities Chapter of the Empire Post met on October 26th at the Binghamton Country Club. There was an enthusiastic turnout of over sixty members and guests to greet the guest speaker, Capt. T. G. Reamy, U.S.N., inspector of naval machinery and ordnance, Schenectady, N.Y.

After a reception and dinner, Michael J. Lawlor, chairman of the Tri-Cities Chapter, greeted the gathering and introduced Col. Edward G. Miller, deputy chief of the Rochester Ordnance District, who summarized the aims and objectives of the American Ordnance Association and explained the importance to the Nation of maintaining a strong Industry-Ordnance Team.

Colonel Miller, who is also secretary of the Empire Post, then introduced Captain Reamy. The speaker's topic was "Problems of Fleet Maintenance," and he described the vast distances that material must be moved to support our ships scattered throughout the world, requiring careful supply management and optimum location of repair bases.

Captain Reamy's engrossing talk was followed by Marine Corps films.

Aberdeen Post Views New Armament Developments at First Meeting

The Aberdeen Post held its first meeting of the season, on October 28th at the plant of Aircraft Armaments, Inc., in Towson, Md., near Baltimore, where 250 members were on hand for a supper meeting and inspection tour.

At the meeting H. D. Duppstadt of Aberdeen Proving Ground, the newly elected Post president, presided.

The first ceremony was the presentation of a Certificate of Appreciation to G. A. Gustafson, retiring president, made by Capt. J. M. P. Wright from National A.O.A. Headquarters.

Maj. Gen. L. H. Watson, now with Fletcher Aviation Corporation, Pasadena, Calif., then delighted the audience with an extemporaneous account of his numerous experiences in dealing with Russians and other Communists in Germany and Korea. He emphasized the need for all industries of the United States to be on the alert to meet the requirements of the armed forces.

The members were next treated to a few of some of the many projects, the unclassified ones, that are being undertaken at Aircraft Armaments, Inc. They saw firings in the underground chambers for testing new caliber .50 developments, tank turrets using newly developed plastic ball and roller bearings, a sun-follower head for the Viking rocket, and a large assortment of radar waveguides.

J. M. Jacobson, general manager of the plant, showed some new developments in the commercial field for industrial closed TV circuits and attachments for home radio to sound an air raid alarm automatically in connection with "Conelrad."

General Cummings Is Principal Speaker at Hartford-Springfield Post Meeting

Two hundred and eighty members of the Hartford-Springfield Post gathered at the Statler Hotel in Hartford, Conn., on the evening of Monday, October 18th, to honor Maj. Gen. Emerson L. Cummings, Chief of Ordnance, United States Army, who was the principal speaker at the annual meeting of the Post. It was an impressive representation of industry and the armed forces—characteristic of the fine Ordnance interest over the years throughout the Post area.

General Cummings in his address stressed the management features of Army Ordnance operations and described in detail the steps that have been and are being taken to improve efficiency throughout the organization, to increase its centralization with adequate responsibility, and to concentrate all activities within certain categories of ordnance under individual commands in the field.

Toastmaster of the meeting was Stanley C. Hope, president of Esso Standard Oil Company and president of the Hartford-Springfield Post.

Presiding at the meeting was Col. Frederick H. Payne, chairman of the Post's board of directors and an Assistant Secretary of War in the Cabinet of President Hoover.

Colonel Payne and Mr. Hope are also national directors of the American Ordnance Association and Mr. Hope was recently elected a vice-president of the National Association. Both were greeted with loud applause and felicitations by their many friends throughout the Post territory.

General charge of the meeting was in the capable hands of J. Alan MacDonnell, Post secretary, whose planning of the arrangements and whose attention to every detail impressed all present.

The following officers and directors of the Post were elected at the brief business meeting which preceded General Cumming's address:

Officers.—Colonel Payne, chairman of the board; Mr. Hope, president; John H. Chaplin, chairman of the board, Veeder-Root, Inc., Hartford, vice-president; Charles H. Granger, Waterbury, vice-president; Mr. MacDonnell, secretary-treasurer.

Directors.—Graham H. Anthony, chairman of the board, Colt's Manufacturing Company, Hartford; John S. Begley, formerly chief, Springfield Ordnance District, Springfield; Mr. Chaplin; Col. W. J. Crowe, formerly commanding officer, Springfield Armory, Springfield; C. K. Davis, formerly president, Remington Arms Company, Bridgeport; Brig. Gen. Guy H. Drewry, formerly chief, Springfield Ordnance District, Springfield; William M. Goss, executive vice-president, Scovill Manufacturing Company, Water-

bury; Mr. Granger; Col. J. L. Guion, formerly commanding officer, Springfield Armory, Springfield; Carl R. Hellstrom, president, Smith & Wesson, Inc., Springfield; Donald P. Hess, chairman of the board, American Bosch Arma Corporation, Springfield; Mr. Hope; also, Col. George E. Hughes, deputy chief, Springfield Ordnance District, Springfield; Col. Douglas G. Ludlam, commanding officer, Springfield Armory, Springfield; Donald G. Millar, president, Greenfield Tap and Die Corporation, Greenfield; Colonel Payne; Herbert H. Pease, chairman of the board, New Britain Machine Company, New Britain; R. E. Pritchard, chairman of the board, Stanley Works, New Britain; Edwin S. Pugsley, New Haven; James Y. Scott, president, Van Norman Company, Springfield; Herman W. Steinkraus, president and chairman of the board, Bridgeport Brass Company, Bridgeport; and James R. Weaver, works manager, Westinghouse Electric Corporation, Springfield.

Greetings to the Post and to General Cummings were expressed on behalf of the national officers and directors of the Association by Col. Leo. A. Codd, executive vice-president of the Association.

Dr. Von Braun, Rocket Expert, Speaks Before San Francisco Post Meeting

The members in the Bay Area who comprise the San Francisco Post assembled at the new International Airport banquet room for their Annual Dinner Meeting on October 25th. The guest of honor was Dr. Wernher von Braun, chief of the Guided Missile Development Division, Redstone Arsenal, Huntsville, Ala. He is one of the world's leading authorities on guided missiles and rockets, an enthusiast on space travel, and influential in development of the Army Ordnance missile, Redstone.

G. M. Greenwood, vice-president of Rheem Manufacturing Company and president of the San Francisco Post, presided at the meeting, attended by approximately 300 Bay Area Association members and their ladies.

Following his opening remarks, Mr. Greenwood called on Col. John M. Stark, deputy chief of the San Francisco Ordnance District and secretary-treasurer of the Post, to introduce Dr. von Braun.

Speaking on man's first efforts to conquer space through the building of rockets and space platforms, Dr. von Braun pointed out that space travel is already here in a limited sense of the word as a result of our armed forces' successful use of high-altitude rockets. "The first important step in space flight is a rocket which will be able to stay in outer space," he stated.

Mr. Greenwood reported that a nominating committee had been appointed for the purpose of selecting nominees to the board of directors. With A. B. Layton, Crown-Zellerbach Corporation, as chairman, the committee consisted of Jean Witter of Dean Witter & Company; Herbert Hall, attorney-at-law; Edward P. Crossan of Johnson & Higgins; and Henry D. Nichols of Tubbs Cordage.

Ballots were distributed to all members of the Post in November, and new officers for the 1955 calendar year were to be elected at the next directors' meeting.

Shown at San Francisco Post meeting are, left to right: G. M. Greenwood, president; Dr. Wernher von Braun, rocket expert, Redstone Arsenal, Ala.; Col. John M. Stark, Post secretary-treasurer and deputy chief, San Francisco Ordnance District.

• **AT DENVER.**—Gen. Benjamin W. Chidlaw, Commander in Chief of the Continental Air Defense Command, was the guest of honor and principal speaker at the annual meeting of the Rocky Mountain Post at the Cosmopolitan Hotel, Denver, October 26, 1954, attended by 300 members and guests.

In his address, General Chidlaw described at length the functions and responsibilities of the Air Defense Command.

James D. Maitland, president of the Post and president of Cobusco Steel Products, presided at the dinner meeting. Col. Leo A. Codd, executive vice-president of the Association, was toastmaster. Maj. Gen. Russell L. Maxwell, president of the New York Post of the Association, extended greetings to the Rocky Mountain Post members on behalf of their Eastern colleagues.

General arrangements for the meeting were under the direction of a committee of which Gerould A. Sabin was chairman. Mr. Sabin is secretary-treasurer of the Post and an official of the Colorado Fuel & Iron Corporation, Denver. Among the other distinguished guests who were seated at the speakers' table were: Dr. William D. Pollock, rector of St. Peter's Episcopal Church and a chaplain in World War II, who pronounced the invocation; Mrs. Gerould A. Sabin; Capt. Dennis J. Sullivan, chief of staff, Naval Forces, Continental Air Defense Command; Maj. Gen. George F. Smith, chief of staff, Headquarters, Air Defense Command; Mrs. William D. Pollock; Lieut. Gen. Stanley R. Mickelsen; Rear Adm. Albert K. Morehouse, commander, Naval Forces, Continental Air Defense Command; Brig. Gen. Marshall S. Roth, deputy chief of staff, Matériel, Headquarters, Air Defense Command; Col. Edward T. Ashworth, acting chief of staff, Army Antiaircraft Command; Col. John F. Fletcher, executive officer to the Commander in Chief, Continental Air Defense Command; Lieut. Col. E. Hayne Shumate, assistant chief of staff, G-4, Army Antiaircraft Command; Maj. James Colasanti, Metal Treating & Research Company, and Mrs. Colasanti.

PITTSBURGH POST VISITS STEEL PLANT

In accordance with the desire of the membership to stimulate more interest in industrial affairs, the Pittsburgh Post scheduled a visit to the Weirton Steel Company, Weirton, W. Va., instead of holding the usual dinner meeting. At 9 a.m. on October 28th the members of the Post boarded a special train made up of new streamlined coaches provided through the courtesy of J. A. Appleton, vice-president of the Pennsylvania Railroad.

At Weirton the party was met by officials of the company and embarked in

buses to visit the coke plant, blast furnaces, and the Bessemer converters.

An excellent buffet lunch was served in the community center where A. E. Walker, president of the Post and chairman of the board, National Supply Company, presided. He extended the thanks of the Post to T. E. Millsop, president of the National Steel Corporation, mayor of Weirton, and vice-president of the Pittsburgh Post, for the complete cooperation and courtesy extended by his organization.

Mr. Millsop responded very graciously, and the meeting adjourned to watch a film entitled "Achievements in Steel." This is a new National Steel Corporation motion picture that reviews the expansion of this corporation and features a comprehensive introduction to steel making.

Following this the party again boarded buses to continue their tour of the plant where they saw the open-hearth furnaces, the strip steel mill, the sheet mill, and the world's largest tin mill.

This was the first trip through a modern steel mill in active operation for many of the more than 300 members and guests, and all voted it a successful and worthwhile event, and a stimulating change from the regular dinner meeting.

CAPITAL CITIES POST MEETS AT WATERVLIET

The Capital Cities Post opened its season with a true Ordnance meeting at Watervliet Arsenal, N.Y., on October 19th.

Over 200 members and 100 guests from the R.O.T.C. Air and Navy Units at Rensselaer Polytechnic Institute reported at the arsenal gate for registration at 2:30 p.m. There they were properly identified and loaded into buses for a tour of the arsenal where they enjoyed a complete view of production on the many calibers of gun barrels and the assembly of barrels with breech rings and mechanisms to produce complete cannon.

Each party ended its tour in the Research and Development Building where an interesting collection showed the various models of cannon as they have gone through improvements over the years. There was also a scattering of foreign weapons for comparison.

In the late afternoon the various parties assembled at the Officers' Club for a pleasant reception before proceeding to the mess hall where more than 200 members and guests attended the dinner meeting.

Earl D. Rhodes, Post president and general superintendent of F. C. Huyck Company, presided and thanked the arsenal for its hospitality and generous assistance to the Capital Cities Post. He then introduced the chairmen of various committees who reported briefly on their activities.

A brief talk by Capt. J. M. P. Wright from A.O.A. Headquarters described present activity in the Association and defined the reasons why membership in the society is now so important to the national defense.

He was followed by the principal speaker of the evening, Col. D. L. Hine, assistant commander of Watervliet Arsenal, who gave a most interesting presentation of the rôle of artillery in Korea.

Empire Post Culminates Busy Program With Annual Dinner at Rochester

The Empire Post culminated a gala 2-day series of A.O.A. activities with its Annual Dinner Meeting at the Oak Hill Country Club, Rochester, on October 7th. There was an enthusiastic turnout of almost 450 members and guests representing all seven Chapters of the Post throughout western New York State.

The preceding day a reception committee headed by Col. Edward G. Miller, deputy chief of the Rochester Ordnance District, met the guest of honor for the occasion, Maj. Gen. Edward J. Timberlake, Commanding General, Ninth Air Force. The general and his staff were welcomed at a get-acquainted luncheon at which Carl S. Hallauer was host.

Throughout the day of October 7th open-house was held at the headquarters of the Rochester Ordnance District and the Rochester Air Procurement Center under the sponsorship of Colonel Miller and Col. Daniel J. Foley.

Many industrial members in the New York State area dropped in to get acquainted, to see the display of equipment, and to discuss their problems with the section heads and learn what the future requirements might be for Army and Air Force armament.

A golf tournament in the afternoon brought out a crowd of about 150 to enjoy the brisk weather and a chance to compete on one of the best-known and most interesting courses in the country.

At the reception and dinner meeting, many ladies and late arrivals joined the golfers in the club's spacious dining hall. The meeting opened with an invocation by Rev. Francis J. Pegnam, a Navy Chaplain during World War II with the Third Fleet. The whole assembly then joined in singing the National Anthem.

Among head-table guests at Empire Post Dinner were, left to right: Maj. Gen. E. J. Timberlake, commanding general of the Ninth Air Force, principal speaker; C. S. Hallauer, toastmaster and past president; and Ray C. Malvin, incumbent president.

After coffee was served, Ray C. Malvin, Post president, greeted the guests and introduced Mr. Hallauer, the genial toastmaster for the occasion, who in turn introduced the guests at the head table—a representative cross section of the Industry-Ordnance Team.

Vice Adm. W. A. Kitts, a director of the Capital Cities Post, and Col. Roy L. Bowlin, a founder of the Empire Post, also were welcomed by the toastmaster.

The Hon. Norman A. Kreckman, vice-mayor of Rochester, complimented the members on behalf of the community for the great industrial activity in the area.

Next, the winner of the golf tournament was presented with the Empire Post Golf Trophy, a beautiful silver bowl for competition by members of the Post.

Capt. J. M. P. Wright from A.O.A.

Association Affairs

Headquarters extended the greetings of the entire Association and presented a certificate of appreciation to Mr. Hallauer for his splendid achievements during his two years in office as president of the Post.

After a friendly welcome by Mr. Hallauer, the guest of honor, General Timberlake, presented an address on "Air Power Security without Bankruptcy." He outlined world conditions to show the need for this country to maintain overwhelming air superiority and explained the necessity for adequate land and sea forces to fight the "small wars."

The meeting closed with a benediction by the Rev. H. C. Burr, executive secretary of the Federation of Churches of Rochester.

Cleveland Post Stages "Little Aberdeen Day" at Erie Ordnance Depot, Lacarne

Over six hundred Cleveland Post members and guests were given a dramatic look at Ordnance operations on October 12th during a Post Industrial Preparedness Tour at the Erie Ordnance Depot, Lacarne, Ohio—an eventful "Little Aberdeen Day."

High point of the inspection trip to the 36-year-old Ordnance proving, repair, and storage installation on Lake Erie, eighty miles west of Cleveland, was a 90-minute firing demonstration. The climactic event during this action program was the first public unveiling of a new battalion antitank weapon, the BAT, rated our most effective tank killer.

Transportation to the Erie Ordnance Depot was by a special 8-car New York Central train from Cleveland's Union Terminal and by private automobiles. Fifteen northern Ohio cities plus Erie and Elwood City, Pa., had delegations, with industrialists and manufacturers from Cleveland, Youngstown, Ravenna, Columbus, Akron, Mansfield, Toledo, Westerville, and Elyria. The deputy chief of the Cleveland Ordnance District, Col. S. W. Connelly, headed a group of seventy from his organization.

Cleveland Post President A. J. Weatherhead, Jr., president of the Weatherhead Company, headed the Cleveland delegation. J. E. Trainer, vice-president of the Firestone Tire & Rubber Company, Akron, and a vice-president of the Cleveland Post, was chairman for the tour, ably assisted by John Cohill.

While waiting for an appetizing boxed chicken luncheon in the Ordnance depot's 17-acre dehumidified warehouse, the members inspected displays by eleven Ordnance manufacturers, including the Cleveland Welding Company, Republic Steel Corporation, Firestone, Cleveland Cadillac Tank Plant Division of General Motors Corporation, Kilgore, Inc., Mullins Manufacturing Company, Weatherhead Company, Baldwin-Lima-Hamilton Corporation, Willys Motors, Inc., Visioneering Corporation, and Perfection Stove Company.

The 640 persons were then taken on tours of the depot, featuring inspection of repair shops, field-service activities, and the vast storage facilities.

Erie Commanding Officer Col. E. W. Grubbs welcomed the industrialists and guests at the firing-line bleachers, and depot teams demonstrated the firing of twenty-three weapons, from the 60-mm. mortar to the 240-mm. howitzer.

Unveiling of the new BAT weapon attracted wide press representation (including one visiting newspaperman from New Zealand). What the visitors saw was a 106-mm. recoilless rifle, M40, mounted on a jeep, with a caliber .50 spotting rifle attached to the larger rifle. A complete account of this new weapon is published on page 553 of this issue.

Conclusion of the Columbus Day Erie tour came with a demonstration of 90-mm. antiaircraft gunnery against a radio-controlled aërial target.

• **AT CEDAR RAPIDS.**—The Quad Cities-Iowa Post enjoyed a full day of plant visits and a luncheon meeting at Cedar Rapids, Iowa, on Friday, October 8, 1954.

Members from the Davenport-Moline area arrived at 9 a.m. and met their fel-

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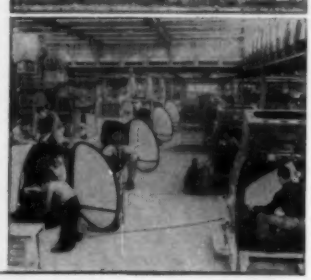

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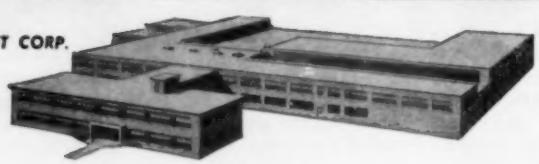

Hunting~ and the Man Who Put Our Freedom on Paper

How do you think of Thomas Jefferson: Author of the Declaration of Independence? Our first Secretary of State? The People's President? True enough, Big Tom was all of these, yet he had a warmly human side most history books have missed. Deep down, Jefferson was a man of five loves: family, friends, farm, horses and hunting.

The passion to hunt consumed him early and never lost its attraction. In his student days "a favorite diversion was hunting on a mountain nearby, which then and long after abounded in deer, turkeys, foxes and other game." Later, even pressing affairs of state and advanced age didn't prevent his following this favorite sport: "He was a keen hunter, as eager after a fox as Washington himself." Whenever he went out with his musket, Jefferson was not the Statesman from Monticello—he was just another excited sportsman enjoying all the pleasures of hunting.

Since our earliest days, Americans have never hesitated to answer hunting's call. For it's an ever-thrilling sport, a sport that challenges wits, reflexes, stamina and skill. Equally important, it helps build self-reliance and endurance . . . a valuable contribution to the nation's well-being.

Today, the great American tradition of hunting can be perpetuated only by thoughtful preservation of wild life. Throughout the country hunting associations are cooperating with public agencies to promote proper conservation. Do your part in preserving this heritage—join or support one of these groups now. E. I. du Pont de Nemours & Co. (Inc.), Explosives Dept., Wilmington 98, Delaware.

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low members from the Cedar Rapids area at the Roosevelt Hotel for coffee. The morning was occupied with a tour of the Link-Belt Company's plant where they saw some of the latest equipment that facilitates the perpetual problem of materials handling.

After luncheon at the Roosevelt Hotel at which Philip E. Mumford presided, the members visited the Iowa Manufacturing Company where operations were in progress on new design and production fabrication of many models of modern construction equipment.

On the second tour of the afternoon at Collins Radio Company, the members enjoyed a review of streamlined manufacturing methods as applied to radio equipment and electronic devices for military application.

On October 11th, the entire membership of the Post was invited to a dinner meeting sponsored by the Moline After Dinner Club to honor Under Secretary of the Army John Slezak.

Among those at the speakers' table were: Maj. Gen. E. L. Cummings, Chief of Army Ordnance; Brig. Gen. Joseph M. Colby, commandant of Frankford Arsenal; and Brig. Gen. T. A. Weyher, commandant of Rock Island Arsenal.

Secretary Slezak explained how the principles of management were being applied in the Department of Defense and gave interesting examples of the direct application of those principles.

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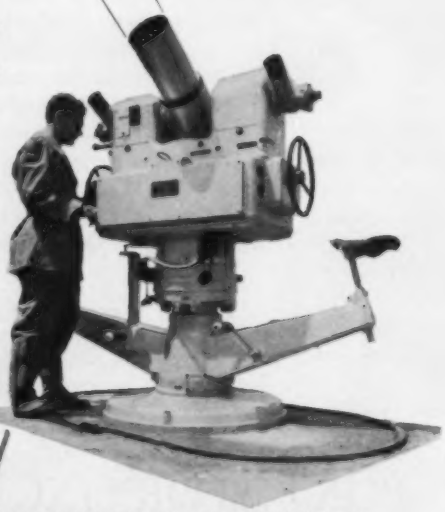

IN UNITED STATES

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WASHINGTON POST HAS ANNUAL GOLFING EVENT

The Army-Navy Country Club was the scene of the Annual American Ordnance Association Golf Tournament sponsored by the Washington Post on Wednesday, October 6th. Members from outlying areas and many guests flocked in to compete for the United States Steel and International Harvester Trophies.

The evening activities were arranged in a delightfully informal manner with members and guests moving into the dining room from the reception as the spirit moved them. However, all were seated promptly in the ballroom when the awards of golf and door prizes commenced.

After greeting the crowd, George M. Riveire, of Goodyear Tire & Rubber Company and Post president, turned the chair over to A. H. Hobelmann, chairman of the Program Committee, to make the presentations. He was assisted by A. E. Decker and other members of the Post.

R. H. Mead, who turned in the low gross score, was presented with a miniature replica of the Benjamin F. Fairless Trophy donated by the United States Steel Corporation. The presentation was made by Clifford F. Hood, president of United States Steel Corporation. The International Harvester Company's John L. McCaffrey Trophy for low net was won by Carl E. Palmer who received the cup from Clarence Crawford, the Washington representative of International Harvester.

The runners-up for the Fairless Trophy were Ralph McGonigall, Robert N. Cook, and Fred T. Marshall; for the McCaffrey Trophy they were G. N. Adams, Robert Temple, and C. C. Miller.

Many other prizes were awarded for prowess in such events as longest drive on No. 13, Robert Hagerty; hole in one or closest to pin on No. 18, R. E. Vernor; low aggregate of par 3's, Lieut. Gen. George Decker.

Prizes were contributed by many industrial firms including Goodyear Tire & Rubber Company, Firestone Tire & Rubber Company, Allis-Chalmers Manufacturing Company, Remington Rand Inc., and Control Instrument Company.

• **AT NEW ORLEANS.**—The wide-awake Chapter of the Louisiana Post in this city met on September 29th at the Colonial Country Club. The guest of honor was Brig. Gen. H. R. Duffie, commanding general, New Orleans Port of Embarkation.

After a reception and a special barbecue dinner, the Post president, W. L. Love, of Rheem Manufacturing Company, conducted a brief business meeting to receive the report of the nominating committe. It was agreed to continue with the present officers for the coming year with nomina-

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tions permitted from the floor at the January elections.

Mr. Love then introduced General Duffie who gave an outstanding talk on over-all defense and preparedness programs.

At the speakers' table with the guest of honor and Mr. Love were Comdr. Marlin C. Ludwig, commander of the New Orleans Naval Ordnance Reserve Company; C. L. Bernard, General Motors Corporation; and T. D. Hoskins, Louisana Light and Power Company.

At New Orleans meeting, above, left to right, are President W. L. Love, Brig. Gen. H. R. Duffie, guest speaker, and Comdr. M. C. Ludwig, Naval Ordnance Reserve.

CINCINNATI POST HOLDS SEMINAR AND DINNER

The annual meeting of the Cincinnati Post was in the Post's finest tradition. There was a technical session in the afternoon and a dinner meeting in the evening. Harold S. Vance, chairman of the executive committee, Studebaker-Packard Corporation, was awarded the Charles L. Harrison Gold Medal for Distinguished Ordnance Service and delivered a memorable address to the more than 450 members and guests who were in attendance.

The technical session of the meeting was held in the North Hall of the Netherland-Plaza Hotel beginning at 3 p.m. The chairman was Col. Clarence A. Cozart, deputy chief of the Cincinnati Ordnance District.

The following papers were presented: "Development and Engineering of a New Ordnance Vehicle to Specification," by Dale B. McCormick, engineering staff of General Motors Corporation, Detroit; "Initiating Production on a New Ordnance Vehicle," by Charles O. Johnson, assistant to the general manufacturing manager, Pontiac Motor Division, General Motors Corporation, Pontiac; "Newest Developments in Automation Gaging," by W. Fay Aller, director of research, the Sheffield Corporation, Dayton.

For the evening program the presiding officer was John D. O'Brien, president of the Post and general manager of the Inland Manufacturing Division of General Motors Corporation, Dayton. The invocation was given by the Rev. Henry W. Sherrill of Cincinnati.

The Harrison award, founded by the family of the late Charles L. Harrison, memorializes the outstanding contributions Colonel Harrison made as chief of the Cincinnati Ordnance District during the First World War and for some twenty years thereafter. The presentation was made by Harvey C. Knowles, a vice-president of the A.O.A. and a vice-president of Procter & Gamble Company, Cincinnati.

The citation accompanying the award was read by Frederick V. Geier, a director of the Cincinnati Post and president of the Cincinnati Milling Machine Company.

In addition to those already named, also seated at the speakers' table were: G. C. Hill, vice-president, 5th Third National Bank; W. W. Tangeman, vice-president, Cincinnati Milling Machine Company; Comdr. F. H. Herrald, III, inspector of Navy material; D. H. March, president, Cincinnati Shaper Company; P. E. Rentschler, president, Hamilton Foundry & Machine Company; Lieut. Col. J. H. Brown, professor of military science and tactics, Xavier University;

Also Col. O. P. Winningstad, former deputy district chief; Col. H. S. Robinson, chief, Cincinnati Ordnance District; R. B. Harrison, son of the late Colonel Harrison; Brig. Gen. William T. Thurman, Wright-Patterson Air Force Base, Dayton; Louis Polk, a vice-president and director of the A.O.A. and president of the Sheffield Corporation, Dayton; Col. Leo

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Association Affairs

A. Codd, executive vice-president, A.O.A.;

Also H. R. LeBlond, president, Cleveland Automatic Machine Company; R. S. Gruver, a director of the Cincinnati Post and a vice-president of Armco Steel Corporation; E. A. Muller, King Machine Tool Company and former district chief; Lieut. Col. C. P. Schneider, assistant professor of military science and tactics, University of Cincinnati; J. B. Doan, former president, Cincinnati Post, and chairman, American Tool Works Company; W. H. Mitchell, Mitchell Steel Company; and H. E. Lunken, president, Lunkenheimer Company.

The recently elected officers and directors of the Post are: John D. O'Brien, president; Perrin G. March, III, vice-president; Henry V. Heuser, vice-president; Robert G. Calton, vice-president; L. W. Scott Alter, national Council member; Mr. Cozart, secretary-treasurer; directors: Mr. Geier, Robert S. Gruver, Mr. Knowles, Mr. LeBlond, Mr. Lunken, Mr. March, David A. Meeker, Mr. Mitchell, Mr. O'Brien, Mr. Rentschler, Mr. Polk, and Harry S. Robinson.

• **MAJ. GEN. SANDERFORD JARMAN** died suddenly on October 15, 1954, in the Veterans Hospital, Boston, Mass., where he was on a business trip. He resided in Washington, D.C.

General Jarman, who was 69 years of age, retired on February 26, 1946, after nearly forty-two years of active Military Service to become assistant to the president of the St. Regis Paper Company.

A native of Boatner, La., and a West Point graduate in the Class of 1908, General Jarman early in his career served as professor of military science and tactics at Louisiana State College. With the outbreak of World War I he went to France on the staff of the 29th Division.

Subsequently he became G-3 on the staff of V Corps and later became active in the operations of the American railway artillery in the Meuse-Argonne offensive. For these services he was awarded the Distinguished Service Medal.

The outbreak of World War II found him commanding general of the Panama Coast Artillery Command for which service he received an Oak Leaf Cluster to the DSM.

Returning to the United States in 1942, he became commanding general of the Antiaircraft Artillery Command of the Eastern Defense Command. He was later transferred to the Western Pacific where he successfully commanded the Mariana Islands and the Western Pacific Base Command of the Pacific Ocean area.

For his services in World War II, General Jarman was awarded two additional Oak Leaf Clusters to the DSM and also the Legion of Merit.—B.O.L.

USS "T-1", A Nickel Alloy Steel, Helps Save Money

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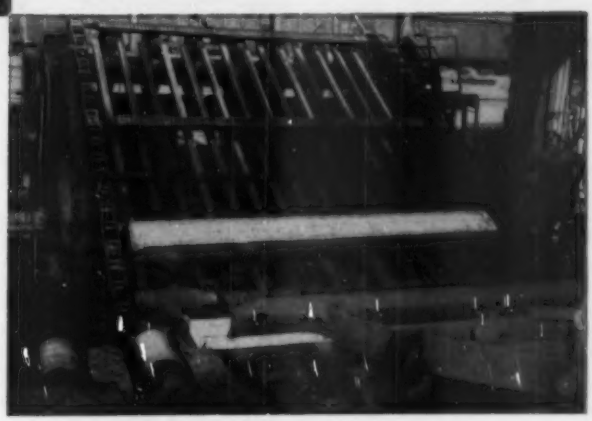

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MATERIALS PROGRESS

George S. Brady

Titanium.—While nickel, zinc, and some other metals have held the spotlight in market news, behind the scenes titanium has been the real Metal of the Year, with perhaps more money and time being spent directly on its research and development than on any other material.

The Malone Committee of the Senate, officially designated as the Minerals, Materials, and Fuels Subcommittee, characterized titanium as a "wonder metal" and claimed that it is essential as a structural material for the advanced designs of supersonic military aircraft.

The subcommittee made specific recommendations for a goal of 150,000 tons of the metal annually. But the present official goal is little more than twenty per cent of that figure, and there is little indication that production can be brought up to the present goal in the near future.

In fact, in an attempt to attain present goals the General Services Administration has been obliged to approve facilities for an unsatisfactory and expensive reduction method because that method is still the only known way of producing the metal in commercial quantities.

Millions of dollars have been expended in research work on titanium, and the judgment on the success of the venture is a matter of viewpoint. Some impatience with the results has been indicated in Congress, but the fact is that we have been trying to do in less than a decade the development work that would normally take at least a generation.

During the past year the cost of production of the crude metal in sponge form has been reduced from $5 to $3 a pound, but the larger costs are in the working of the metal into commercial forms. Fabricating the metal into usable forms has presented difficulties not encountered on any other common metal and on which there was no previous experience.

The 2-phase crystalline structure of the metal called for experimentation with alloys wherein a balance might be obtained and, since the development and trial of alloys requires much time, it is not to be expected that we can have immediate success.

It must be remembered that the development of the present balanced stainless steel required almost forty years even though much was known of steel alloying in advance of the stainless steels.

But an outstanding difficulty in the working of titanium is the fact that the physical properties are greatly affected by even slight absorption of the atmospheric gases, oxygen, hydrogen, and nitrogen. For this reason, the hot-rolling of the presently known alloys must be done in a neutral atmosphere.

The cost of finished sheets and shapes has thus been running to $20 or more a pound, and thin sheets for special electrical uses have reached as high as $40 a pound.

While it is conceded that the suggested annual production of 150,000 tons of this exceptionally strong and heat-resistant light metal would be essential for the many military applications in any emergency, it can be seen that there is little commercial market for the metal at present high prices.

Lower-cost methods of working the metal must be found, and an economical method of remelting the scrap has yet to be developed. New alloys that can be worked better than the pure metal are being investigated constantly. One of the latest of these is Alloy 3A1-5Cr, of the *Mallory-Sharon Titanium Corporation*, Niles, Ohio. This alloy contains 3 percent aluminum, 5 chromium, 0.10 carbon, and the balance titanium.

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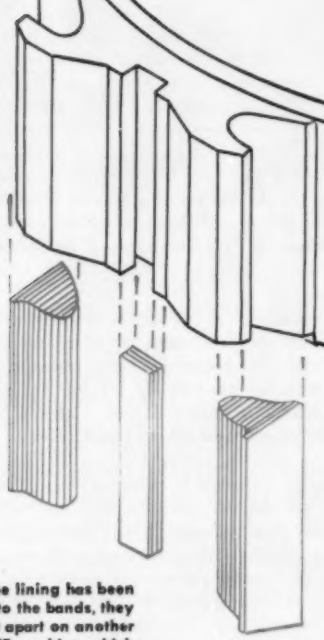

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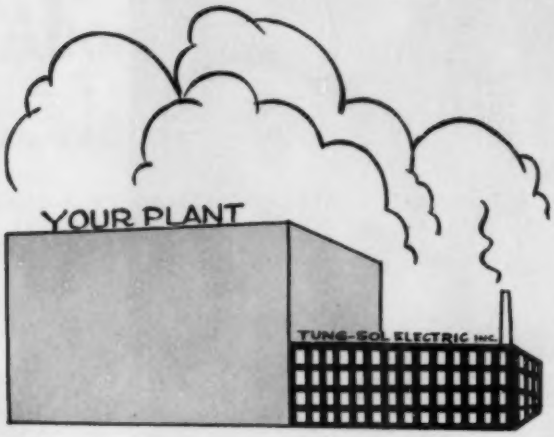

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Materials Progress

Aluminum is a stabilizer of the alpha phase, or hexagonal structure, of titanium, and chromium is a stabilizer of the beta, or cubic structure, which forms at the forging temperature.

Though only about two-thirds the weight of steel, the alloy has a tensile strength of 155,000 pounds per square inch, with elongation of 13.5 per cent. It forges well, and it can be welded to give a weld strength equal to that of the parent metal. It is highly corrosion resistant and retains good strength at elevated temperatures.

All the producing companies now have titanium alloys that can be depended upon to give satisfactory service in the military applications, but they are all still in the high-cost range, and it must be said that knowledge of alloying and working titanium is yet in the pioneer stage.

Aluminum-Steel Cable.—With 2,500 miles of expanded ACSR (aluminum conductor, steel-reënforced) projected for the Ohio Valley electric development, this type of cable is being featured for super-high-voltage transmission.

The cable, as produced by the *Aluminum Company of America*, has a core of steel wires over which is a filler of kraft paper twine to increase the size enough to minimize corona effects without using more metal. The aluminum wires are wound over this filler.

Thus, with an increase in cable diameter of about fifteen per cent, but without increase in the weight of metal, substantially higher voltages can be transmitted. More than eighty per cent of the high-voltage installations now being made in the United States and Canada are of aluminum wire.

Aluminum Jibs.—In order to span the larger ships now coming into the Purfleet (England) dock, the 80-foot steel jibs of the 7½-ton cranes were replaced by 90-foot aluminum jibs with remarkable savings in weight and increased efficiency. Angle extrusions of aluminum alloy were used for the booms and bracing members, connecting with aluminum alloy rivets, cold-driven.

The aluminum-alloy jibs have a 0.006-inch coating of pure aluminum sprayed on, and no painting is used. The 90-foot jib weighs 2½ tons, compared with 6½ tons for the former 80-foot jib. The jibs were built by the *Clyde Crane & Engineering Company, Ltd.*

Light Crash Trucks.—New Air Force crash trucks, Model 0-10, have the bodies and fully enclosed cabs built entirely of aluminum, all welded. The bodies are being manufactured on a production-line basis by the *Oneida Products Corporation*, Canastota, N. Y., while the hose reel, made also of aluminum, is built by *C. B. Hannay & Sons*, Westerlo, N. Y.

One-piece Forgings.—The wings of the new Douglas X-3 Air Force supersonic jet airplane are machined from 2,000-pound one-piece contoured aluminum-alloy (14S) forgings. Formed in one piece in the forging are the spar caps, stringers, and ribs. The forging is then machine-tapered and machined to an egg-crate pattern, after which a tapered skin of 24-S-T86 aluminum alloy is attached to each side. The forgings were made by the *Aluminum Company of America.*

For other types of aircraft forgings where good ductility is desired in large sections of three inches thickness or greater, this company has developed a new alloy designated as X7079. It is a modification of the heat-treatable zinc-copper-magnesium-chromium type of alloy, with physical characteristics similar to alloy 75S but with better forging ability.

Plastic Pipe.—By adding twenty-seven new designs of special fittings to its line of plastic pipe fittings, *Franklin Plastics, Inc.*, Franklin, Pa., now believes that installations of plastic pipe can

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be made with considerable savings in the number of fitted connections compared with normal usage on metal piping. The material used in the fittings is a styrene copolymer, and the line includes threaded reducing tees, extra-length couplings, and long and short adapters.

The *B. F. Goodrich Company*, Akron, Ohio, also has a new line of extruded rigid Koroseal plastic pipe and threaded fittings. The pipe, gray in color, comes in 20-foot lengths in sizes from one-half to two inches. Besides its light weight and high resistance to corrosive action of chemicals, it has excellent aging properties for outside or underground applications. The low coefficient of friction results in less drop in line pressure than with metal pipe.

New Auto Bodies.—The body of the new experimental gas-turbine automobile, the XP-21 Firebird, built by the *General Motors Corporation*, Detroit, Mich., is of glass-fiber-reënforced polyester resin, with the seat also of plastic. The cover over the driver's seat is of laminated plastic, consisting of two transparent acrylic sheets interlined with a transparent polyvinyl butyrate sheet. The fuel tank is of reënforced plastic.

The *Ford Motor Company* also has an FX, or "future experimental" passenger automobile with a sleek-lined body of reënforced plastic. The enclosure over the seat is of fully transparent plastic. The car can use a conventional engine, but the style and type of engine is left for future design.

Sintered Battery Plates.—Nickel battery plates for the new type of nickel-cadmium storage battery are being made by the *Amplex Division, Chrysler Corporation*, by pressing and sintering nickel carbonyl powder of six to thirty microns' particle size. The resulting sintered plate of nickel has a porosity of 80 per cent. The new batteries will operate from minus 65 to plus 165 degrees Fahrenheit, can be fully charged in an hour, and give long life.

Nylon for Polishing.—For barrel polishing of nonferrous metal and plastic parts, the *Rampe Manufacturing Company*, Cleveland, Ohio, has tumbling media molded of nylon. The molded slugs are called Nylaslugs, and are particularly adapted for deburring and polishing delicate parts.

Rubber Roads.—Starting with experimental roads in Holland, foreign natural rubber interests have been pushing the use of rubber surfacing of roads in order to develop a new market for the surplus supplies of natural rubber. But American engineers have determined that synthetic rubbers are better for the purpose.

The *U. S. Rubber Company*, New York, N.Y., is offering cube-shaped pellets of unvulcanized synthetic rubber to mix with asphalt for road topping. From six to twelve pounds of the pellets are added to a ton of asphalt. The rubber improves the bond between the asphalt and the stone aggregate, prevents water from seeping down, and keeps the asphalt oil from rising to the surface of the road.

Molded Plastics.—During the Korean war molded plastics were adopted for appliance housings by some companies only because of the shortage of metals, but the plastic housing designs being used today are claimed to have distinct advantages over metal housings. Typical of the new designs is the head frame of the new Beautiflor waxer of *S. C. Johnson & Son, Inc.*, Racine, Wis., which is of injection-molded, high-impact cellulose acetate. Reënforcing ribs on the underside give it rigidity, and small ribs molded into the handle socket hold the wooden handle firmly. Besides saving weight, the plastic frame retains its bright color finish and is easy to keep clean.

Plastic Bellows.—Bellows for use as vibration dampers, expansion joints, and connectors for piping are being made of Teflon (tetrafluoror ethylene) by the *Crane Packing Company*, Chicago, Ill. The plastic bellows are strong, flexible, highly chemical resistant, and good for pressures to 125 pounds per square inch. They remain flexible at subzero temperatures and will withstand heat to 500 degrees Fahrenheit.

New Silicone Rubber.—The *General Electric Company*, Pittsfield, Mass., has a new grade of silicone rubber, SE-965, which does not require milling, can be extruded easily, and does not need to be oven baked. It has the good insulating properties of the silicones and is being offered for wire and cable insulation. It also can be readily tinted to any color. The cured rubber remains flexible to temperatures as low as minus 65 and will withstand heat to 300 degrees Fahrenheit.

Aluminized Cloth.—An aluminized cloth which will reflect ninety per cent of the radiant heat striking it is being marketed by the *American Optical Company*, for use in making workers' protective clothing. The fibers are metalized with aluminum and then woven into a herringbone-weave fabric. The fabric is flexible, and the metal does not crack off.

Glass-fiber Tape.—For electrical insulating uses, *Hess, Goldsmith & Company*, New York, N.Y., has a new glass-fiber tape called Hesgon that has an exceptionally uniform weave to give uniform high

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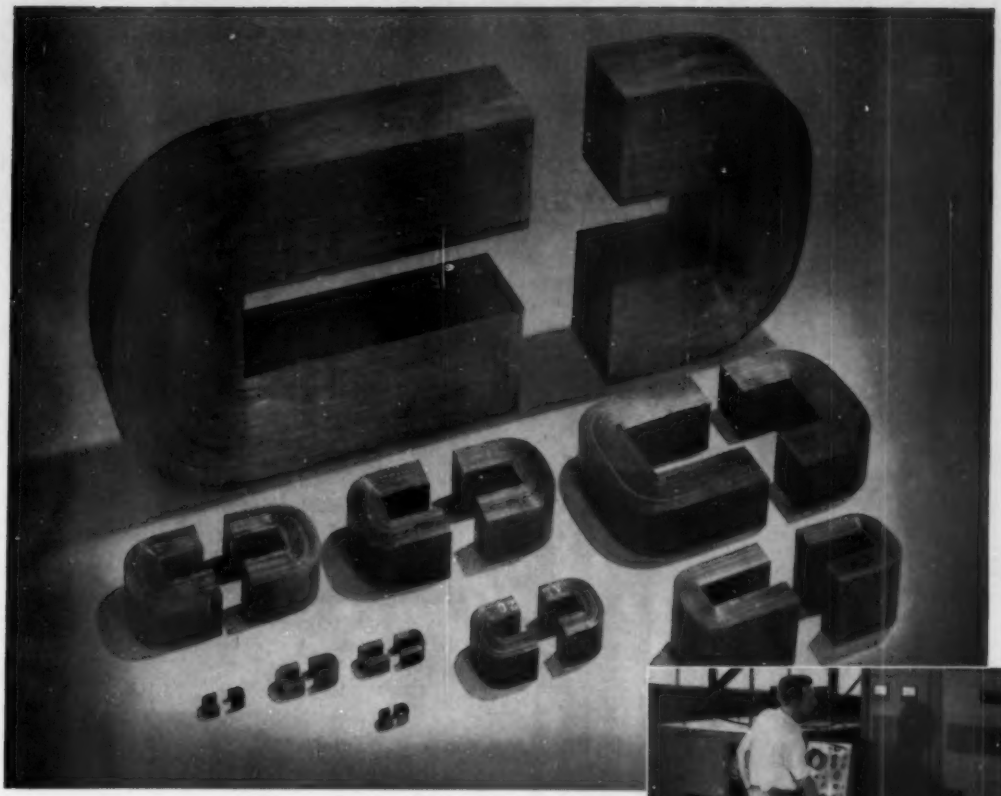

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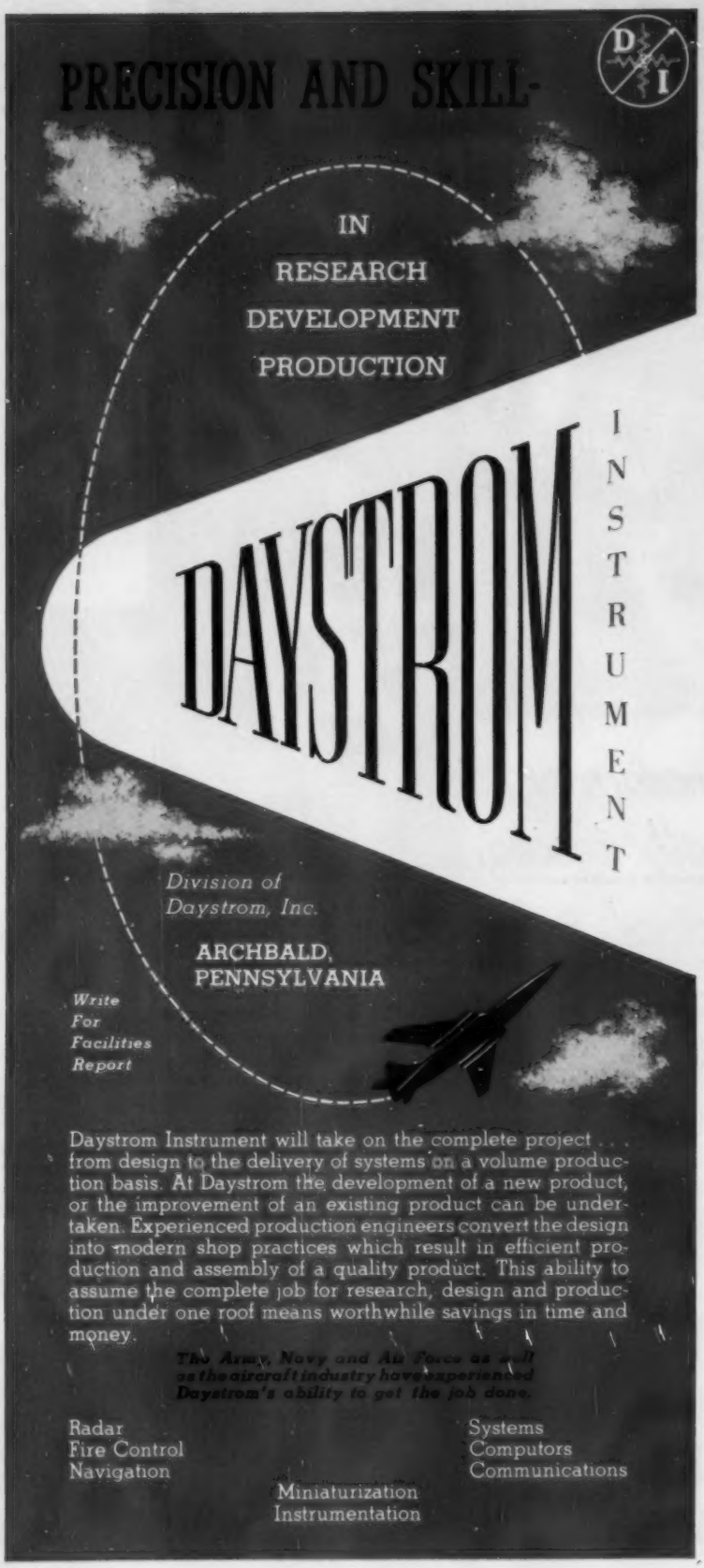
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Materials Progress

strength and resistance to moisture and chemicals. The tape comes in thicknesses from 0.004- to 0.015-inch and in widths from ½ to 1½ inches. It may also be had in an open weave.

Materials Markets.—Some idea of the changes that are taking place in basic materials markets can be seen from a study of a few current statistics. For example, it is estimated that 250 million polyethylene plastic bottles were made in 1954 to replace glass bottles, more than a 60 per cent increase over 1953. In 1954, also, more than twenty per cent of all dinnerware dishes made were in plastics, mostly melamine, to replace chinaware.

Around a billion metal cans were made in 1954 for soft drinks formerly sold in bottles, and about a third of all packaged beer is now put up in cans. These cans are lacquered with a resinous lacquer on the metal sheet, and then the finished can is given an inside coating of vinyl resin.

Aluminum Drums.—*Reynolds Metals Company* has been featuring the savings made by the use of aluminum drums to replace steel drums for the shipment of chemicals. The average saving in shipping charges is around ten per cent. The handling is easier because of the light weight, they are rustproof and need no costly linings, and they have a higher salvage value.

Aluminum Dump Trucks.—All-welded aluminum hoist dump trucks being built by the *Hockensmith Corporation*, Penn, Pa., weigh only 5,500 pounds, including the hoist, compared with a weight of 8,500 pounds for a similar steel body, making a payload saving of 3,000 pounds. The inside width of the body is seven feet, and the lightweight aluminum tail gate can be handled by one man. The corrosion resistance is superior to that of steel, no painting is required, and maintenance costs are lower.

Titanium Tests.—A series of tests has been made by Langley Aëronautical Laboratory to ascertain the physical properties of titanium carbide utilizing a nickel bond instead of the scarcer cobalt which is customarily used with tungsten carbides. It was found that while the hardness of the carbides with 5 and 10 per cent nickel binder is superior to that with a greater percentage of binder, and that the compressive strength is also satisfactory, the tensile and shear strengths of those with 20 and 30 per cent binder are superior and more desirable for tool use and for heat-resistant applications. With 20 per cent nickel binder the tensile strength of the sintered tool is 77,000 p.s.i., and the shear strength is 95,000 p.s.i.

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Designers and production men are well aware of forces constantly exerted in and around assembled parts. They are the reasons behind the universal acceptance of the nut, bolt and lock washer type of industrial fastening. A Reliance Spring Lock Washer has the reactive range and reactive pressure to keep tension in a bolted assembly long after wear, vibration and bolt elongation have destroyed the effectiveness of a less efficient type of fastening. That is why we say Reliance Spring Lock Washers keep bolted assemblies *tighter longer*. For complete information, write for engineering folder W-50. No obligation.

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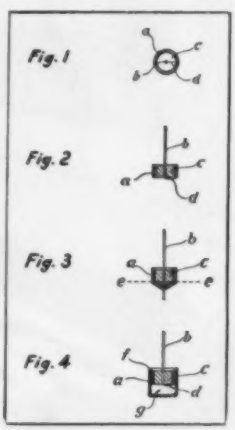
RECENT PATENTS

This department on recent military-industrial patents is being published in ORDNANCE *to keep our readers informed of the latest developments in these fields. The data are compiled by Melvin Nord, patent attorney, Detroit, Mich. Copies of patents may be obtained from the Commissioner of Patents, Washington 25, D.C., at 25 cents each.*—THE EDITORS.

PRIMER FOR IGNITING EXPLOSIVES

• *U.S. Patent No. 2,687,667. Issued August 31, 1954. Ulrich Gunther. Assigned to Inventa A.G. fur Forschung und Patentsverwertung, Zurich, Switzerland.*—In the ordinary type of electrical primer the explosive is mixed with a binder which slows up its activity, and the fire wire is also coated with a binder which retards the heat exchange between the wire and the explosive. In the present patent, these disadvantages are avoided.



New electric primer

As shown in Figs. 1, 2, and 3, the outer shell *a* originally has the form of a small cup with a conical bottom. This bottom has a central bore through which the wire *b* is passed, forming the inner pole. The interior of the cup is then filled with a liquid insulating mass which later solidifies (for example, it may be fused enamel powder). After the mass has solidified, the pointed bottom of the cup is ground or filed off along the line *e-e*, and the firing wire is fastened on top.

The finished primer is shown in Fig. 4. The assembly previously prepared is pressed into cup *f*, which contains the primer explosive under high compression. For ignition, current flows over the outer pole *f* and the inner pole *b* and across the spark gap between *a* and *b*.

FLIGHT TRAINING APPARATUS

• *U.S. Patent No. 2,687,580. Issued August 31, 1954. Richard C. Dehmel, Short Hills, N.J.*—This patent describes a flight-training apparatus for pilots for computing flight conditions and simulating force reaction on the pilot that occurs in actual flight while rotating about the three axes of the aircraft during such maneuvers as pitching, banking, and turning. According to the inventor, the apparatus simulates the "seat of pants" reaction which occurs during actual flight maneuvers due to combined gravity, acceleration, and centrifugal forces acting on the pilot.

JET-ROTATED HELICOPTER

• *U.S. Patent No. 2,689,614. Issued September 21, 1954. Dudley B. Spaulding. Assigned to National Research Development Corporation, London, England.*—Ramjets attached to the rotor blades (one jet per blade) propel the rotor of a helicopter in this invention. The fuel is fed as a film to a number of transverse

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DESIGNER AND MANUFACTURER OF ORDNANCE EQUIPMENT
The Aetna-Standard Engineering Company
FRICK BUILDING
PITTSBURGH, PENNA.

Recent Patents

rods in the jet ducts, arranged in grid form. During combustion, evaporation of fuel takes place from the leading surface of the rods. Vapor mixes with oncoming air and meets hot combustion products and vapor which have been circulated in reverse flow in the wake of the rod. Heat from the rearwardly extending flame is transferred to the rods and thus provides the necessary latent heat to evaporate more fuel.

AMMUNITION PRIMING MIXTURE

• *U.S. Patent No. 2,689,788. Issued September 21, 1954. Joseph F. Kenney. Assigned to Remington Arms Company, Bridgeport, Conn.*—The compound disclosed in this patent is friction- and percussion-sensitive and is deficient in oxygen, so that in ammunition priming it is capable of serving the dual purpose of either combustion initiation or fuel or both. Furthermore, it decomposes under impact at such a rate and with such energy that it is capable of functioning as the sole explosive ingredient. The compound is a double iron salt of styphnic acid and hypophosphorous acid, having the formula

$$[C_6H(NO_2)_2O_2]_3Fe_2 \cdot 4Fe(H_2PO_2)_3$$

A method of preparation is described in the patent.

The use of this compound has been found to enable the production of noncorrosive priming compositions which are entirely free of lead and other toxic compounds. The use of such priming compositions in cartridges containing lead-free projectiles enables the manufacture of complete cartridges which are nontoxic.

AËRIAL BOMB CLUSTER

• *U.S. Patent No. 2,690,122. Issued September 28, 1954. James C. Darnell, Jr., and Lars M. Eidsness, Jr. Assigned to the Secretary of the Navy.*—This patent provides an improved aërial bomb cluster which safely retains a group of bombs in a compact cluster as long as they are carried within and shortly after they are released from an aircraft and which then automatically disperses the individual bombs to permit them to fall as separate units.

PROJECTILE FUZE RECOVERY ASSEMBLY

• *U.S. Patent No. 2,690,126. Issued September 28, 1954. Walter S. Finken and Leonard P. Frieder. Assigned to General Textile Mills, Inc., New York, N.Y.*—This invention provides an assembly in which a new type of fuze may be installed in a large-caliber projectile, fired from a gun, and recovered after it has been fired to ascertain whether it functions properly or, in the event of malfuctioning, the reason for its failure.

ROCKET REACTANT FEED SYSTEM

• *U.S. Patent No. 2,687,168. Issued August 24, 1954. Robert P. Hairland. Assigned to General Electric Company.*—In order to obtain the maximum possible final velocity and range of a rocket it is very important that the fuel and oxidizer reactants be exhausted simultaneously. If one per cent of either reactant is left unreacted in the rocket, the final velocity may be reduced by ten per cent and the range by twenty per cent.

In the present patent, the desired result is achieved by the use of reactant tank level floats connected through an electrical bridge system to a valve-adjusting means in one of the reactant feed lines.

INDUCTION FIRING MEANS FOR ROCKETS

• *U.S. Patent No. 2,690,124. Issued September 28, 1954. John M. Melick. Assigned to the Secretary of the Army.*—Prior to this invention, when a rocket was to be fired electrically it was necessary to make positive electrical connection with the rocket from a source of voltage after the rocket had been loaded into the launcher tube. Poor contacts sometimes led to misfires. In addition, firing in combat was slowed down. The present method avoids these problems by permitting the rocket to be fired by induction without external wiring connections.

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Weed Killers **Weed and Brush Killer**

"Telvar" has kept this yard clean of vegetation for two years.

Note thorough job "Telvar" did around this fence. "Telvar" won't corrode fence or equipment; it's non-flammable, non-volatile.

Heavy weed growth around pole was controlled with one application of "Telvar." It's easily applied and extremely low in toxicity to humans and animals.

One application of "Telvar" solves weed problems for a season or longer!

"Telvar" kills through the roots . . . prevents regrowth. Low dosages (20 to 80 lbs. per acre) make it cost little for the results you obtain. Low rates also mean less handling, less storage facilities. If you're looking for a way to cut maintenance costs to new low levels, include "Telvar" in your weed-control program. Available in two formulations: "Telvar" W; and "Telvar" DW, which is especially suited for light, sandy soils and in areas where annual rainfall is higher than 20 inches.

"Ammate" kills more kinds of brush and keeps it down longer than most weed and brush killers!

When the original spray job is well done, brush is kept under control with nothing more than an occasional spot spray later. You can rely on "Ammate" to do the job safely, even where your rights-of-way adjoin crop land, because "Ammate" is not volatile. There are no vapors to drift onto sensitive crops.

FREE ILLUSTRATED BOOKLETS describe how to control weeds and brush with Du Pont chemicals. For your copies, write to Du Pont, Grasselli Chemicals Dept., Rm. D 4038, Wilmington, Del. In Canada—Du Pont Company of Canada Limited, Montreal, Box 660, Canada.

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"Ammate," applied five years ago, is still keeping brush down along this right-of-way.

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Same right-of-way as above, three years after treatment. Brush still under control; low-growing cover returned to resist erosion.

GOVERNMENT FINISH SPECIFICATIONS

and the Parker Products which meet them

This list contains specifications most frequently called for, and some of the Parker Products which meet them. There are Parker Products to meet almost every one of the less frequently used government specifications also. A letter or telephone call to Parker, Detroit, will secure specific information on products to meet government specifications not listed here.

SPECIFICATION	PARKER PRODUCTS
JAN-C-490 (Replaces AXS-1245 and may be superseded by MIL-C-490A)	
Grade I	Bonderite 100, 160, 170, 180
Grade II	
Type 2	Parco Cleaners 341, 350, 371
Type 4	Parco Cleaners 250, 260
Type 5	Parco Cleaners 210, 220
Type 6	Parco Cleaners 100, 101, 110
MIL-10578A (Formerly U.S.A. 3-213)	
Type I (Wash-off)	Parco Cleaner 250
Type II (Wipe-off)	Parco Cleaner 260
MIL-C-5541 (Formerly AN-C-170)	Bonderite 700, 710, 720 (chemical film for aluminum and its alloys)
MIL-C-12968 (ORD) (Supersedes in part U.S.A. 57-0-2)	
Type A—(Formerly U.S.A. 57-0-2, Type I, Class A & A1)	Parco Powder, Parco Lubrite 1 & 2
Type B	
Class 1 (Formerly U. S. A. 57-0-2, Type II, Class B	Parco Compound
Class 2	Parco Compound plus Endurion
MIL-C-16232A (BuORD)	
Type I	Parco Lubrite 1 & 2
Type II	Parco Compound
PA-PD-191	
Grade I	Bonderite 32, 34, 100, 160, 170, 180
Grade II	
Type 2	Parco Cleaners 341, 350, 371
Type 4	Parco Cleaners 250, 260
Type 5	Parco Cleaners 210, 220
Type 6	Parco Cleaners 100, 101, 110
U.S.A. 72-53	Bonderite 32, 34, 100, 160, 170, 180
U.S.A. 57-0-2 [See also MIL-C-12968 (ORD)]	
Type II	
Class A & A1	Parco Lubrite 1 & 2
Class B	Parco Powder—Parco Compound
Class C	Bonderite 100, 160, 170, 180

For information regarding these or other specifications, write

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FIRST IN THE FIELD SINCE 1915

NEW DEVELOPMENTS

SUPERSONIC FIGHTER

The F101A Voodoo, a supersonic, long-range, strategic fighter built for the United States Air Force by the McDonnell Aircraft Corporation, made its initial public appearance recently.

Dimensions of the Voodoo are: 39.7-foot wing span, 67.4-foot length, and 18-foot height. Both wings and stabilizer are swept back thirty-five degrees. The wing skin consists of preformed sections. The Voodoo employs a tricycle landing gear and retractable speed brakes housed in the aft fuselage section and is equipped with a parabrake—a parachute stored in the tail compartment which may be released by the pilot to reduce the landing roll. Its two Pratt & Whitney J-57 turbojet engines develop a total of approximately 20,000 pounds of thrust.

LIGHTWEIGHT TRUCK

An experimental all-aluminum Army truck weighing 6,000 pounds less than the conventional model and utilizing a fuel-injection system, hydraulic disk brakes, and ball-joint suspension has been developed by the Chrysler Corporation. Although not scheduled for quantity production, the "idea" truck already has influenced the design of military vehicles slated for volume production.

Chrysler was asked by the Detroit Arsenal to design a truck that would be lighter than the conventional Army vehicle so

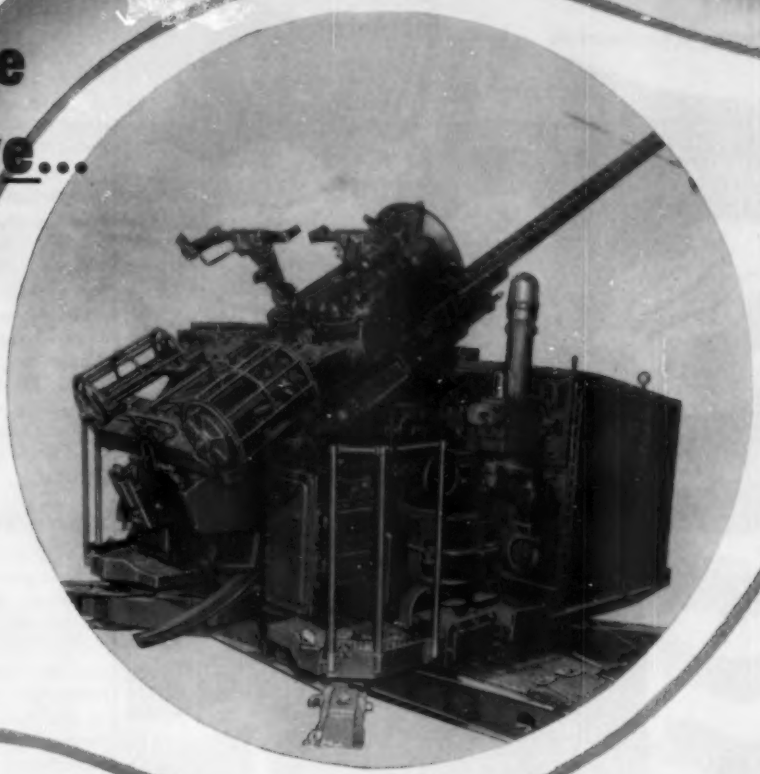
The T55 experimental lightweight truck.

that it could be used for airborne operations but would carry the same load. The result was the T55, a cab-ahead-of-engine 2½-ton truck with 6-wheel drive that weighed only 9,000 pounds compared with the 14,000-15,000-pound weight of the conventional 2½-ton Army truck.

The body of the truck is made of aluminum, including the wheels and axles. The front and rear axles are identical and interchangeable. Each wheel is individually suspended with torsion-bar springing and each wheel has disk brakes operated by an air-assisted hydraulic system. An automatic gearshift makes the truck virtually impossible to stall. The aluminum cab has an open top that can be covered with a special plastic cover. The windshield of the truck slides up and down instead of folding flat on the hood.

The truck has a waterproof 6-cylinder, 200-horsepower, air-cooled engine and is capable of speeds of over 60 miles an hour. Instead of a carburetor, a fuel-injection system is used. The T55 can climb a sixty per cent grade and with its waterproof engine and ignition system, together with a fording kit, can cross deep streams under its own power.

AC builds brains for the Big Eye...



At strategic spots throughout the country you'll find them—the "big eyes" of America's defense. What are they? These T-38 Skysweepers are radar "eyes" that automatically sweep our skies in a never-ending vigil.

The "brains" are fire control units—one of the most important electro-mechanical devices yet developed—which can spot, track and fire at any planes within their line of sight.

AC is proud of its contributions to development of the "big eye," and proud of the AC mark stamped on these complex units.

This is just one more example of AC's demonstrated ability in the electro-mechanical field. Do you have a problem of this nature? Let AC lend a hand. Why not give them a call now?

This AC-developed machine reduced test time from 40 hours to 2 hours per unit

AC DEFENSE PRODUCTS

AC SPARK PLUG DIVISION
—THE ELECTRONICS DIVISION OF GENERAL MOTORS
FLINT, MICHIGAN

DEFENSE PRODUCTS of High Quality at Low Cost DELIVERED ON TIME

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If service conditions are unusually rugged and you're troubled by high manufacturing costs—look to pearlitic malleable castings!

Pearlitic malleable has high fluidity that casts easily into complicated shapes. It resists wear under heavy loads at high speeds . . . has high ultimate strength . . . possesses excellent non-seizing properties for bearing surfaces . . . can be given a very smooth finish where desired . . . and can be either liquid quenched or air quenched. And perhaps *most important of all, pearlitic malleable machinability index ranges from 80 to 90* (B1112 steel = 100).

So look your product over critically. Then check pearlitic malleable castings. They can replace more expensive methods of fabrication or manufacture . . . can lead to reduced weight, less machining time . . . fewer assembly operations . . . *greater sales appeal for your product.* AA-100

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New Developments

TERRIER AA MISSILE

In the air-defense phase of the Atlantic Fleet's largest postwar exercise, Lantflex 1-55, the old converted battleship U.S.S. MISSISSIPPI successfully employed the Navy's new antiaircraft weapon, the supersonic guided missile "Terrier." The Terrier, capable of being fired from either shipboard or ground stations, has completed its test program which began in the spring of 1952 at the Naval Ordnance Test Station, Inyokern, Calif., and has since included extensive test firings at sea from the converted seaplane tender NORTON SOUND and the MISSISSIPPI.

Because of the high percentage of successful flights in the Terrier's test program, almost all launchings against target drone aircraft have been made by dummy missiles that did not carry explosive warheads. The dummy signals a "kill" by releasing a puff of smoke near the target airplane. Even without warheads, the missile has smashed several targets by direct collision.

TINY GYROCOMPASS

The development of the world's smallest nautical gyrocompass, light enough to be carried by small naval or civilian craft, was recently announced by the Navy. The miniature gyrocompass, the result of coöperative effort by the Navy and the marine division of the Sperry Gyroscope Company, will permit small craft to navigate with direct-reading true-north accuracy.

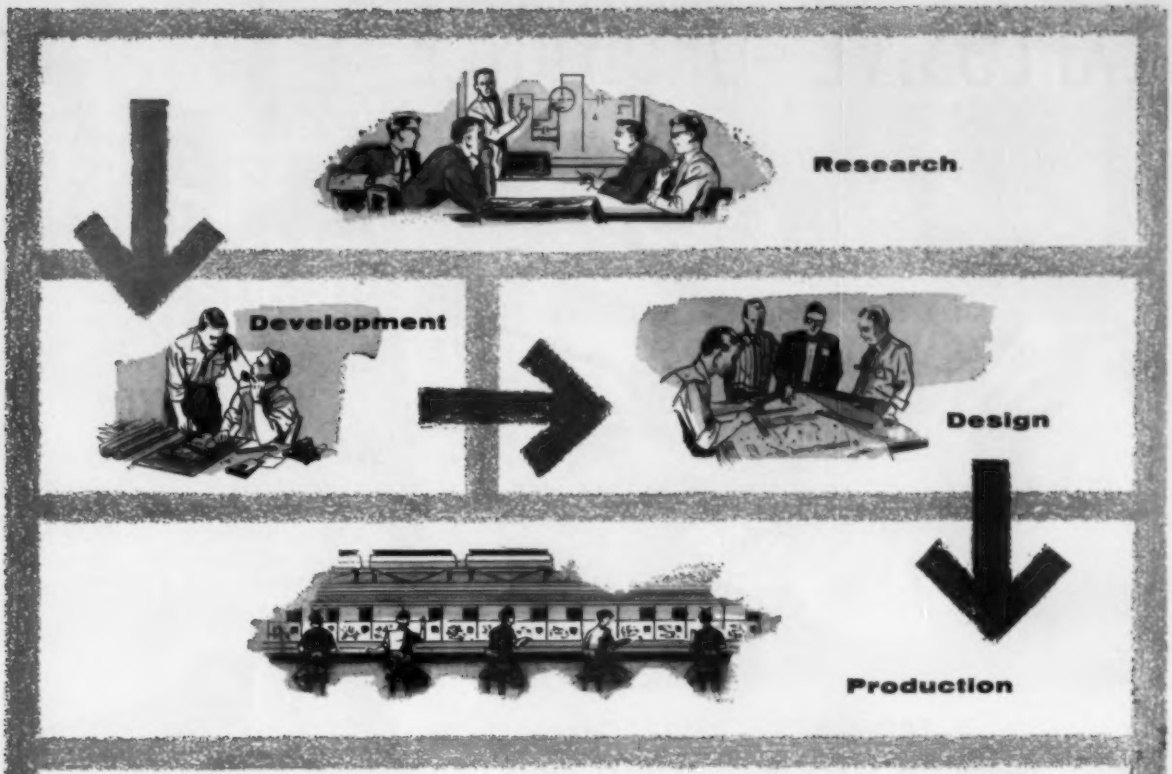
The Mark 22

The Navy anticipates widespread use of the new instrument in the fleet, particularly on certain landing craft and amphibious vehicles of several types.

Occupying less than half a cubic foot of space, the 9-pound Mark *22* compares favorably in performance with present-day 900-pound master gyros which stand four feet high. It fits easily on a shelf close to the steering station, so that a steering repeater system is unnecessary. Its extreme simplicity permits operation by personnel without specialized gyrocompass training, and its design simplifies replacement in the field of complete units or components as required.

ELECTRONIC GAGES

The National Bureau of Standards has recently developed three types of instruments for measuring the thickness of electrodeposited coatings. While all three instruments depend upon the difference in electrical conductivity between the plating and the basis metal, each makes use of



AN INTEGRATED ELECTRONICS OPERATION

Navigational Gear
Guided Missiles
Radar
Noise Rejection
Counter Measures
Computers
Communications
Terminal Equipment
Transistors

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Hoffman's reputation for getting things done is due, in part, to the unification of Research-Development-Design-Production into one closely integrated electronics operation. At Hoffman – instead of the usual four completely separate operations – one technical director is assigned to co-ordinate each new project from start to finish. Every new project is developed in close cooperation with the divisions ahead, including the practical problems of quantity production. This integration practically eliminates the all-too-common duplications and overlapping of functions, the errors and re-work caused by poor liaison, and materially cuts down the usual time lag between the testing of the prototype and actual production. Hoffman has become a leader in electronics by doing progressively complex jobs – to specifications – to cost estimates – and on schedule.

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A large portion of Aerojet-General's 14,000-acre plant site near Sacramento, California, has been allocated to the ordnance program. This large area affords the necessary space and facilities for explosive loading and warhead evaluation, yet is adjacent to labor, related industries, and transportation.

Aerojet-General's objective in expanding its ordnance operations is to provide the Armed Forces with integrated facilities, both in development and in production, for warheads and explosive devices as well as ordnance rockets, and related items of armament.

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A Subsidiary of The General Tire & Rubber Company

THE GENERAL TIRE

AZUSA, CALIFORNIA
CINCINNATI, OHIO
SACRAMENTO, CALIFORNIA

New Developments

different methods for sensing specimen resistance.

Two of the instruments, the "Dermitron" and the phase-angle thickness meter, utilize electromagnetic coupling to the specimen, making use of the reflected field from eddy currents induced in the specimen. A third, a waveguide inspection tool, employs direct conductivity measurement with point electrode. All three devices permit simple nondestructive determination of plating thickness or of sample thickness for homogeneous metals. When appropriately calibrated, they can be used for measurement of magnetic as well as nonmagnetic materials.

ZERO LENGTH LAUNCHER

Additional information on the launching equipment for the Martin B-61 Matador missile was released recently by the Air Research and Development Command. The launching device, a specially constructed semitrailer called a "zero length launcher," with supporting equipment operates in an area of only one hundred square feet without the use of a runway. Only one part of the device moves during the operation and that only a few inches.

The Matador on its launcher.

The launcher consists of a 39-foot tandem-axle semitrailer weighing 35,000 pounds without the missile, a motor generator, blower, hydraulic pump, and a wing rack. Though a self-contained unit in itself, it is supported by auxiliary equipment, such as a 28-foot, 15,000-pound transport semitrailer, a 5-ton tactical truck tractor, and a 20-ton truck-mounted crane.

The missile is mounted on the launcher by a 3-point suspension. Two ball-and-socket supports at the front point the weapon upward at a 15-degree angle. The rear support is in the form of a bolt that keeps the missile from moving until full power is attained at which time the bolt shears and allows the missile to take off. At this point the front supports swing forward a few inches and drop away from the missile. This allows clearance for the booster bottle attached to the rear of the Matador.

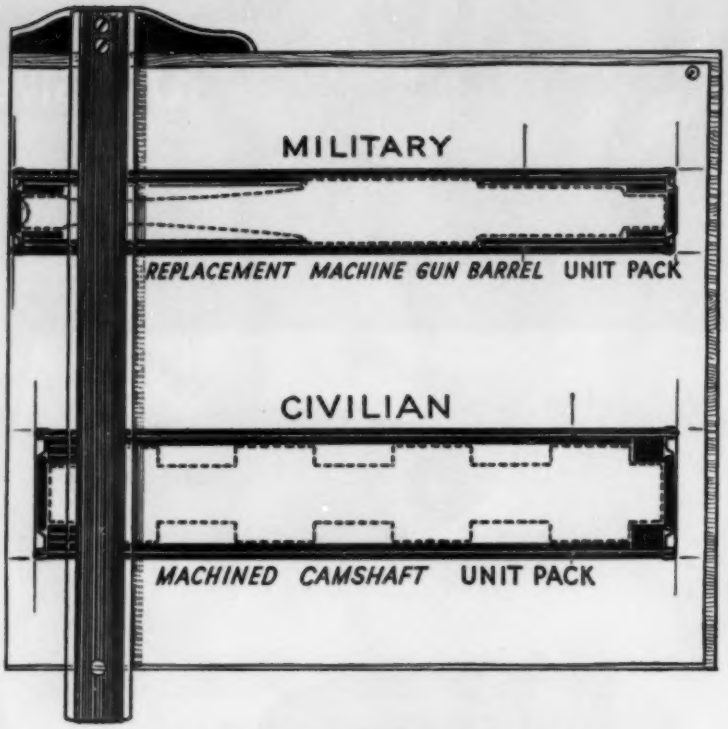
DEDICATED TO GOVERNMENT PRODUCTION . . . EXCLUSIVELY

Rheem

Rheem's integrated plant facilities are completely equipped to handle every phase of research . . . engineering . . . and production. Present projects include the production of air frames, missile components, jet engine components, airborne ordnance and electronics.

These outstanding facilities cover nearly one-half million square feet of floor space on 50 acres of ground. They constitute a major industrial investment in national security . . . and are at your disposal. Write, wire or phone for full details.

RHEEM Manufacturing Company . . . Government Products Division, Downey, California



CLEVELAND CONTAINERS

Military spare parts, highly machined metal parts, delicate electro-mechanisms and fragile items can be packaged better, and at less cost, in fibre containers.

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. . . Economical cubage and weight.
. . . Reduction or elimination of intermediate and overpacks.
. . . Tailored to your product—built-in cushioning, special barriers and liners where required.
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Cleveland Container Canada, Ltd.: PLANTS AND SALES OFFICES: Toronto and Prescott, Ont. • SALES OFFICE: Montreal.

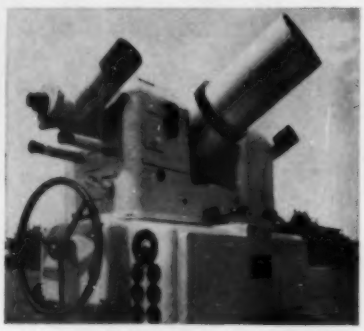
New Developments

DIAMOND RECOVERY

The Industrial Test Laboratory at the Philadelphia Naval Yard has been giving special attention to diamond recovery from industrial diamond wastes. An electrostatic separator has been used successfully for separating diamonds from South African ore concentrates. Electrostatic separation depends upon the utilization of the difference between dielectric properties of diamonds and other minerals present in the ore concentrate. In electrostatic fields of the same intensity, diamonds will accept and retain a relatively large electrostatic charge in comparison with most other mineral substances and this property of diamonds is effectively used to separate them from other minerals.

NEW MISSILE TRACKER

Outstanding accuracy is the key feature of a new Swiss phototheodolite designed for tracking guided missiles and aircraft. The new equipment records time, position,



The Swiss phototheodolite.

and attitude of the tracking target on 35-mm. film at rates of ten or thirty frames a second.

Maximum tracking speed is thirty degrees a second. Dynamic accuracy of the theodolite is better than 0.1 mil. At a range of 10,000 feet this corresponds to an error of less than one foot.

In multiple installations the theodolites are controlled and synchronized by a master station. Remote positioning, radar slaving, program control, and instant trajectory indicators are also available.

THE INDUCTOSYN

A new angular data transmission device called the Inductosyn has been developed by the Farrand Optical Company of New York under an Air Force contract. The device has maximum errors of only five seconds of arc in an experimental system. The data elements are inductive in nature with the conductors being formed by photo-etched patterns on glass plates. The use of the Inductosyn as a back-lash-free electronic gear ratio is one of its useful and novel applications.

N-A-X
ALLOY STEELS

MODERN STEELS for MODERN TRANSPORTATION

- **N-A-X HIGH-TENSILE** steel—a low-alloy high strength structural steel used to reduce weight and increase life of your product.
- **N-A-X AC 9115** steel—for gas turbines and similar products requiring strength of material when operated at higher than normal temperatures up to 1000°F.
- **N-A-X 9100** series—alloy steels for carburizing and heat treated parts.

With these three N-A-X ALLOY STEELS, we offer time proven products to economically serve you.

N-A-X HIGH-TENSILE is 50% stronger than mild carbon steel with high notch toughness. Has excellent cold forming and welding properties and greater resistance to atmospheric corrosion and abrasion.

N-A-X AC 9115—a steel easily fabricated and welded by any method, maintains high strength at elevated temperatures up to 1000°F. When protected against high temperature oxidation by proper coatings, it is a worthy alternate for the higher-alloy stainless type steels for this application.

N-A-X 9100 series—a series of alloy steels with the alloying elements constant within an established range, with carbon varied to suit the hardenability and hardness desired. An outstanding carburizing steel.

GREAT LAKES STEEL CORPORATION

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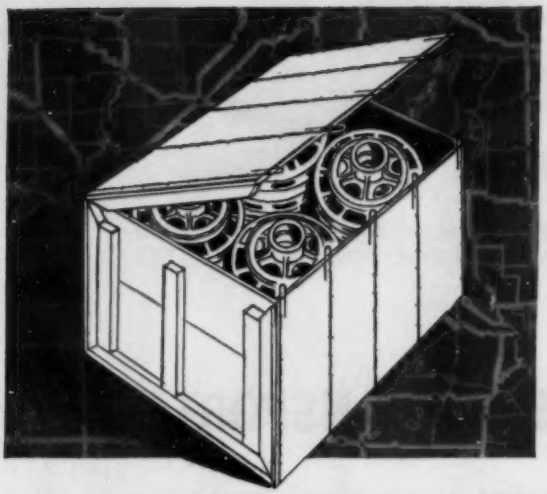

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Book REVIEWS

Reviews in this issue by:

COL. JOHN D. BILLINGSLEY, *educator, ordnance authority, author, United States Military Academy, West Point, N. Y.*

F. W. FOSTER GLEASON, *military historian, ordnance analyst, editor, Washington, D. C.*

COL. CALVIN GODDARD, *small-arms authority, military historian, author, Washington, D. C.*

COMDR. R. E. JEFFERY, *educator, ordnance expert, United States Naval Academy, Annapolis, Md.*

COL. PHILIP SCHWARTZ, *author, ordnance expert, Pasadena, Calif.*

CAPT. J. M. P. WRIGHT, U.S.N., Ret., *staff consultant for local Posts, American Ordnance Association, Washington, D. C.*

Power and Policy. By Thomas K. Finletter. New York: Harcourt Brace & Company. 408 pp. $5.

WHEN the Communist world decides that it has superiority over Western Europe and the United States, it will strike without warning to attain rapidly its goal of world domination. It has hesitated so far because of the superior nuclear-weapon stockpile in the United States. This country, now holding the stronger retaliatory powers, is falling behind and will be wiped out unless our air power is bolstered immediately.

This is Mr. Finletter's basic thesis which he elaborates with full discussions of our problems in the "gray areas" of the Eastern Hemisphere and our existing military policy.

His recommendations include a 2-department defense establishment and a United Nations world police force to replace the world's armed forces. Defense should return to the "2-party system" consisting of a Department of the Army and a Department of Air-Navy to replace the present top-heavy Department of Defense with three subdepartments.

The world police force, an old UN dream, is Mr. Finletter's solution for preventing wars, although he admits that no country on final analysis would care to let their affairs be supervised by strange nationals—an essential feature for successful peace-keeping.

Although you may disagree with Mr. Finletter's thesis there are sobering discussions and good background information in his book.—J. M. P. WRIGHT.

Japan's Decision to Surrender. By Robert J. C. Butow. Stanford: Stanford University Press. 259 pp. $4.

A WELL-DOCUMENTED reference work on how an unsuccessful war may be ended and in particular how this occurred in Japan in 1945. It consists largely of a compilation of the records of individual events which led up to the final unconditional surrender. The author does not insert too many of his personal opinions and for this reason appears to be quite accurate and reliable. Although it may be classed as a work of history, the book is not necessarily dry reading.

The most important impression left with the reader is that the Japanese Army started the war with the United States, conducted it in an unsuccessful manner, and at the end stubbornly refused to accept any method of termination of the war short of national suicide.

Most of the members of the Emperor's court as well as the senior members of the civil government (except the heads of the

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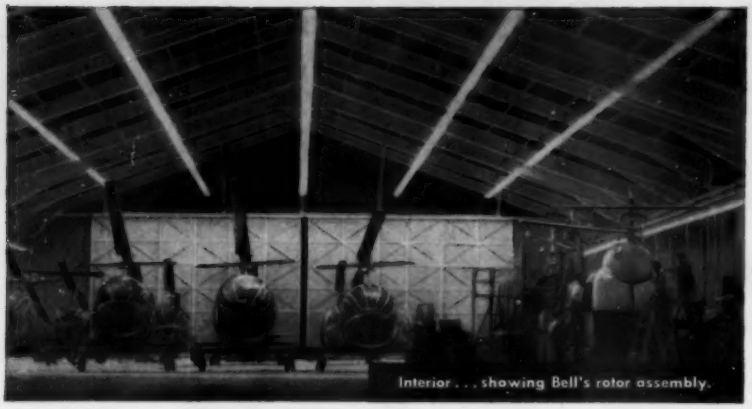

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army and navy) realized that the final defeat of Germany in the spring of 1945 was an unpleasant omen of what would probably happen to Japan unless something drastic was done to prevent it.

The members of the court and the government believed that the continuation of Japan as a nation and the Emperor as the ruler of Japan were more important than winning or losing a war.

The Japanese Army, however, had indoctrinated its members from top to bottom with the win-or-die concept, and it refused to support any Japanese moves directed toward seeking peace. It did everything possible to hinder peace efforts —even by threatening the lives of the members of the government. It was only after the Emperor himself had personally asked the army heads to support the peace moves that they finally gave grudging assent to the negotiations which ended the war.

There appears to be little doubt that the almost simultaneous Russian declaration of war and atomic bombing of two Japanese cities in the first part of August 1945 were the straws (rather heavy) which forced the responsible Japanese authorities quickly to accept the unconditional surrender demands contained in the Potsdam Proclamation of July 26, 1945.—PHILIP SCHWARTZ.

We Remained. By Col. R. W. Volckmann. New York: W. W. Norton Company. 244 pp. $3.75.

THIS short volume, its title antithetic to MacArthur's "I shall return," portrays most interestingly the story of those dedicated souls, Filipino and American, who devoted (and often gave) their lives to combating the Japanese occupation of "the Islands" from the fall of Bataan and Corregidor to Yamashita's official surrender at Baguio on September 3, 1945.

One of many who refused to accept surrender when Bataan fell, Volckmann made his way, after many perilous experiences, to northern Luzon, where he eventually became commander of United States Armed Forces in the Philippines, Northern Luzon. This was rather rapid progress for one who had been a temporary captain (and a permanent lieutenant) when World War II commenced.

To accord him proper recognition compatible with his command (guerrilla colonels being a dime a dozen in some other areas of Luzon), his subordinates circulated, and signed, a resolution to the effect that ". . . we . . . do hereby elect R. W. Volckmann to the unofficial rank of colonel and do severally and jointly agree to speak of him by that title." A higher testimonial to the regard of juniors toward their senior would be difficult to discover.

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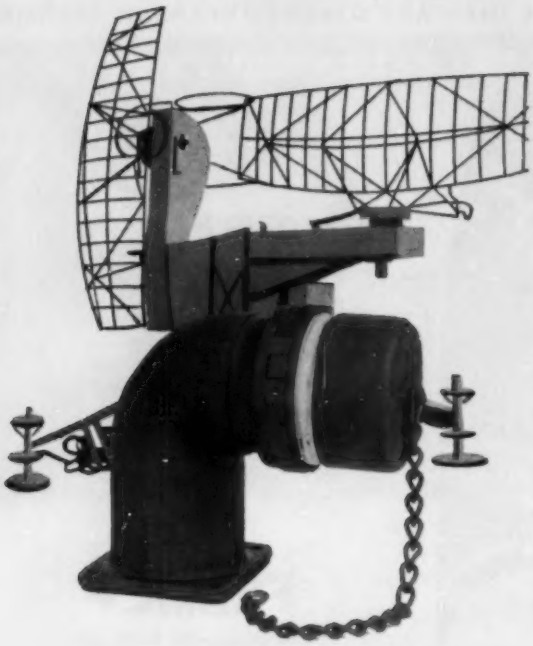

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The account of how the resistance forces under Volckmann were recruited and trained, and of how they operated, makes a fascinating recital, one which will appeal especially to those familiar with the topography of Luzon. In which connection, it should here be observed that the usefulness of the volume is terrifically impaired by the inadequacy of the few maps which it contains. What a pity, when more and better maps would have been so easy to supply!

This little volume is an interesting, if not an epochmaking, contribution to the story of guerrilla operations in the Philippines. It ends with a chapter in which the author speculates upon the importance of the guerrilla in the war of tomorrow.—CALVIN GODDARD.

Close Contact. By Brig. C. H. Dewhurst, O.B.E. Boston: Houghton Mifflin Company. 173 pp. $4.

WHEN clear of Soviet censorship, the traveler relates impressions that are possibly planted, the press representative releases his censored reports, and the escapee reviews his hardships.

Brigadier Dewhurst, on the other hand, from his vantage point on a military mission retained a broad perspective and with masterful understatements presents a graphic portrait of the baffling Communist-Russian and arrives at some interesting estimates of future Soviet actions.

The brigadier, a student of Russia for twenty years, after five years in Yugoslavia and Eastern Germany was in a favorable position to observe Soviet officialdom in operation. His determined effort to ignore rebuffs was rewarded by a broad acquaintance with Russians in all walks of life. He draws some convincing conclusions on Soviet strength, weakness of satellite countries, and the sense of inferiority that is behind so many of their bombastic actions and statements.

The author also shows that Western nations are too generous in release of their technical information and weak in their attempts to acquaint Russian satellite people with the true meaning of democracy.

This book is the most refreshing down-to-earth commentary on Communist-Russian people and their way of life that has appeared for many years. It is essential reading for all those who hope to understand them.—J. M. P. WRIGHT.

Confederate Agent: A Discovery in History. By James D. Horan. New York: Crown Publishers, Inc. 326 pp. $5.

IN 1951, the author, a newspaper and historical writer, was working on the papers of one of the most famous Confederate spies, Mrs. Rose O'Neal Greenhow. Her dispatches led to inquiries which, in turn, led to the writing of this volume.

Although some of the single exploits, notably the attempt on New York City and the raid on Vermont, have appeared in print, this is the first compilation to be published. The Civil War conspiracy files of the War Department, sealed for ninety years, have been opened. Many personal papers of the conspirators, not previously made known, were furnished by their descendants.

Capt. Thomas H. Hines, C.S.A., was the mastermind of an amazing plan to bring Illinois, Indiana, and Ohio into the Confederacy and to paralyze the Northern States with widespread, organized revolt. Of necessity such a story demands a great body of documentation, for it is well-nigh incredible in its ramifications. An imposing listing of sources is furnished as well as a large bibliography.

Of course the whole lurid story could never be uncovered in the first attempt. Sufficient has been turned up, however, and enough documentation given to encourage and guide the historian in further work on this fascinating course.

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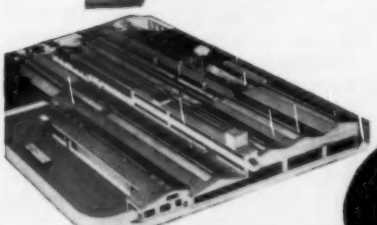

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Book Reviews

The account of Captain Hines' mission explains some puzzling aspects of the war, especially Morgan's famous raids into the Northwest. Much of the record is proved; much more is now an "educated guess" to be dug out and revealed in future works from the clues furnished by Mr. Horan's intriguing book.—F. W. FOSTER GLEASON.

The Midget Raiders. By C. E. T. Warren and James Benson. New York: William Sloan Associates. 318 pp. $4.50.

TWO laconic young men describe, in this book, the origin, growth, and World War II combat operations of that amazing unit of the Royal Navy's Submarine Forces which was prodded into being by the insistent recommendations of Winston Churchill himself.

This unit was composed of 4-man submarines, called "X-craft," and manned and ridden torpedoes called "Chariots." The gallant officers and men who took these weapons into combat became known as "Charioteers."

The human-torpedo program was begun in 1942 as a stopgap enterprise until the first midget submarines could be constructed. Brave men experimented with human endurance limits as they learned about their deadly chariots. Less than a year after the first call for volunteers for this hazardous service, the torpedo riders successfully attacked six Italian vessels in Palermo Harbor.

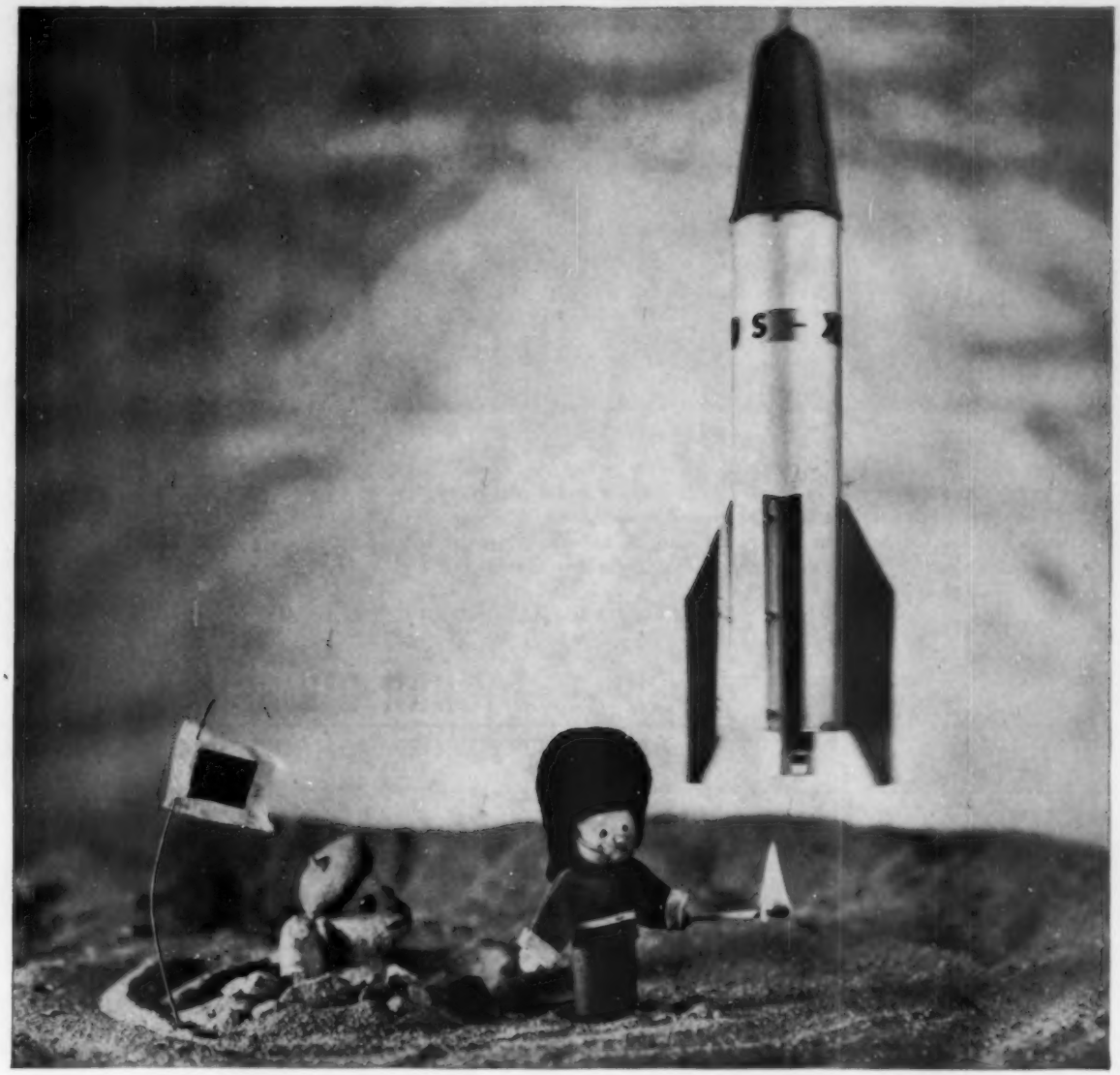
Eight months after the Palermo attack the midget submarines, the X-craft, made their marvelous effort against the TIRPITZ and put that battle cruiser out of action for many months.—R. E. JEFFERY.

The Battle History of the 1st Armored Division. By George F. Howe. Washington: Combat Forces Press. 438 pp. $6.50.

THIS book, in the words of Robert E. Bard, historian, 1st Armored Division, has the mission of preserving the battle chronicle of brave men and of acclaiming their valor in the true perspective of their accomplishments.

The 1st Armored Division was the first such division to go overseas, to engage German troops in World War II, to land in Algeria, and to enter Rome. It had the longest combat record of any armored division during the war.

Mr. Howe has presented a very difficult battle history in a manner which will be especially interesting to those who served with the 1st Armored Division during the period covered and will be helpful for those interested in an analysis of armored tactical doctrine.—JOHN D. BILLINGSLEY.



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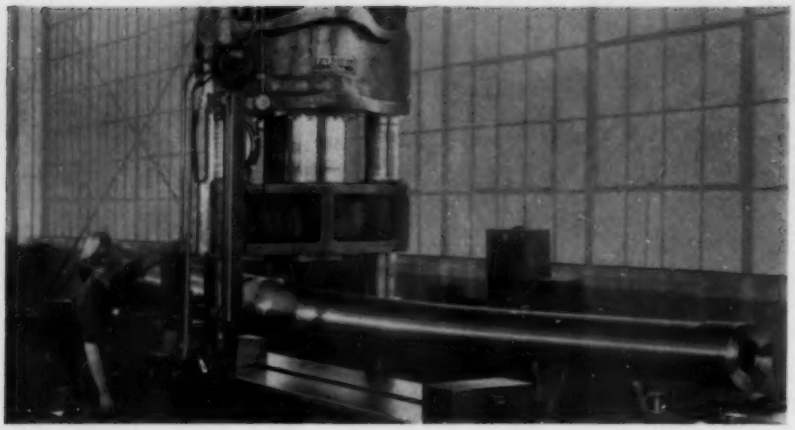

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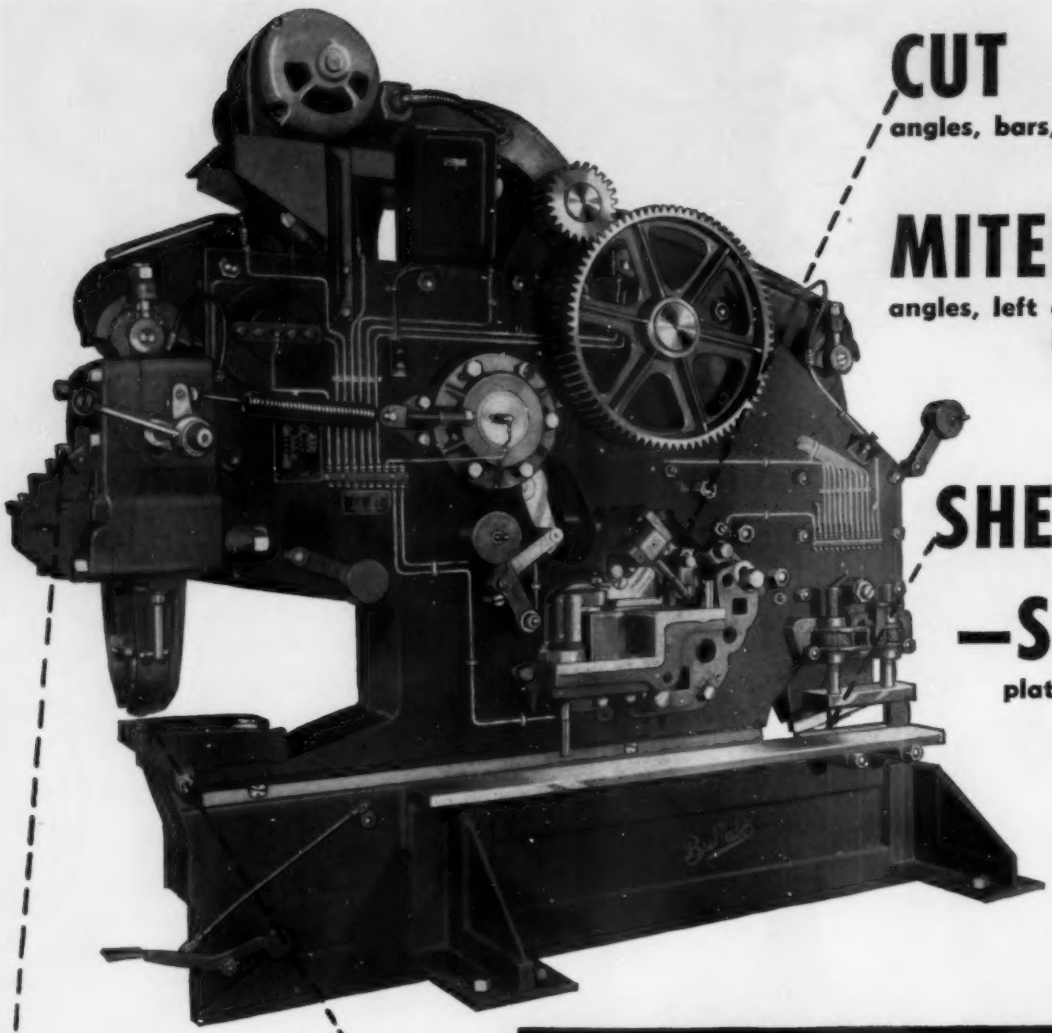

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angles, bars, tees

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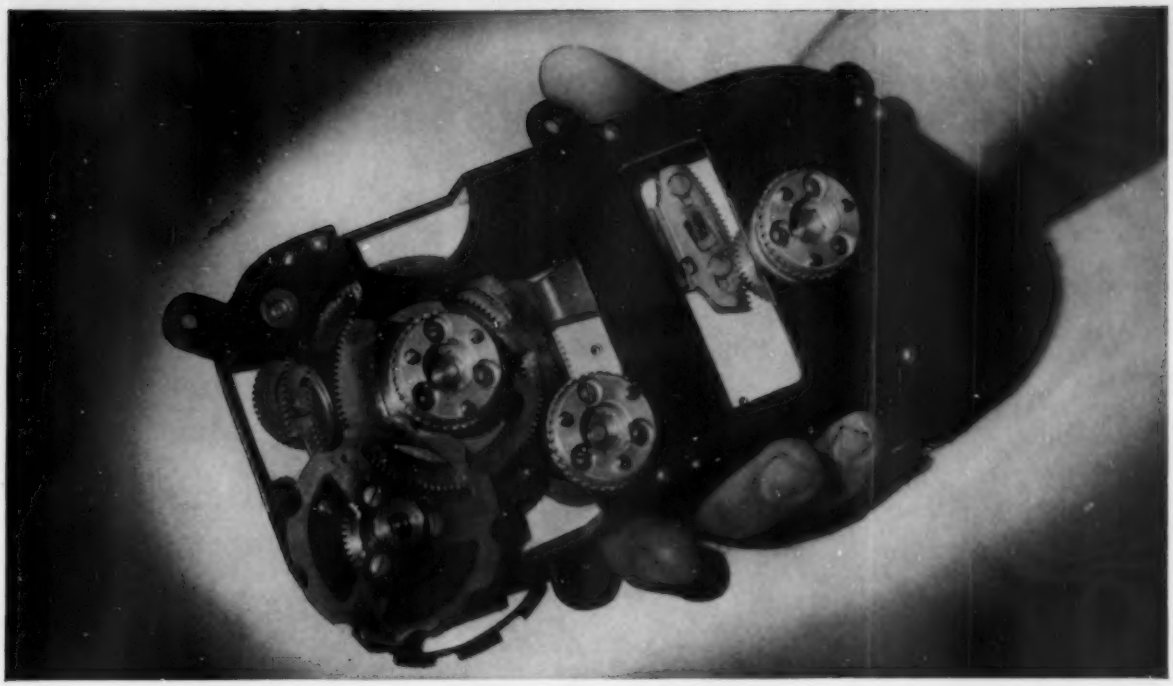

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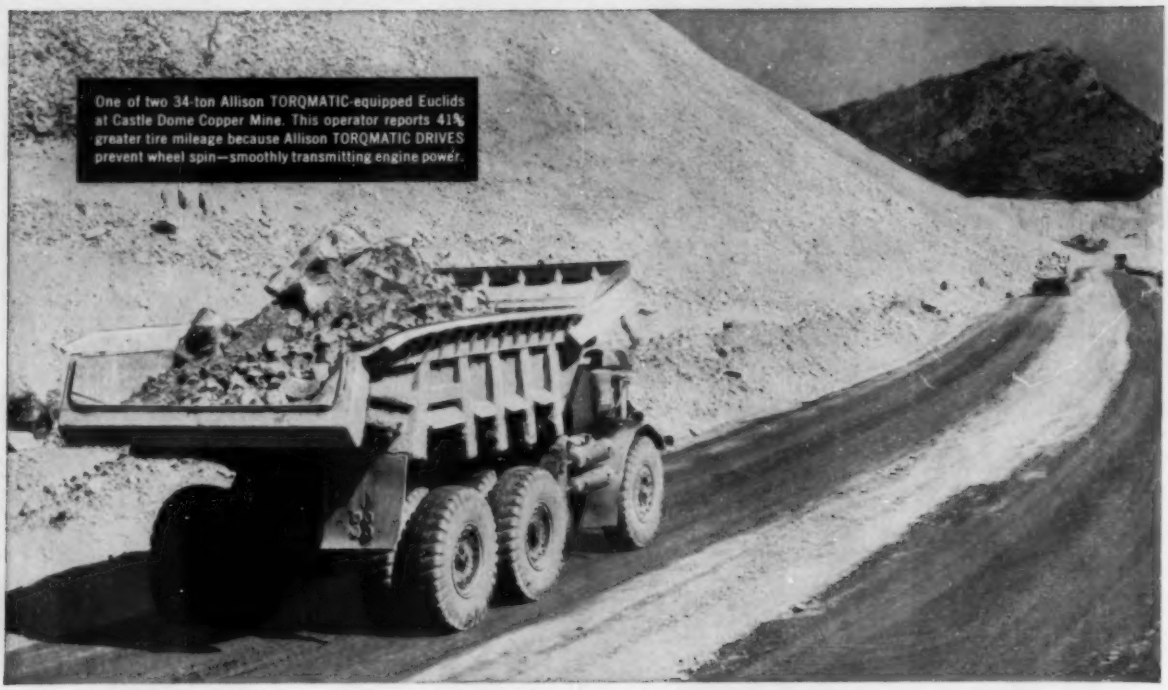

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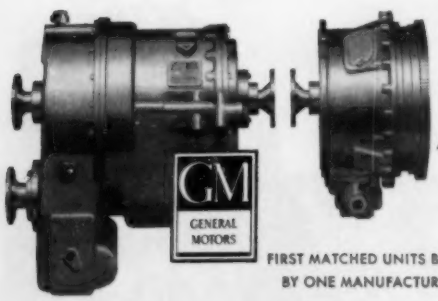

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Yep! We'll do just about anything to prove a point especially when the point is "Kreolite" Kountersunk Lug. Protruding slightly on the sides of the block, it assures consistent spacing which in turn guarantees even and free flow of Kreolite Pitch Filler. Kreolite Wood Block Floors have been installed at the rate of 36,000 square feet a day and have been maintained for 20 years on as little as 1/3c per square foot.

Coated with "Kreolite Jennite", it is a clean, comfortable floor to work and walk on, absorbs noise and vibration and is dust-skid-and-spark proof.

A Jennison-Wright flooring expert will call at your request.

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3 Resilient . . . protects dropped tools and parts
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13 Spark-proof, skid-proof, safe . . . with "Kreolite Jennite" Filler.
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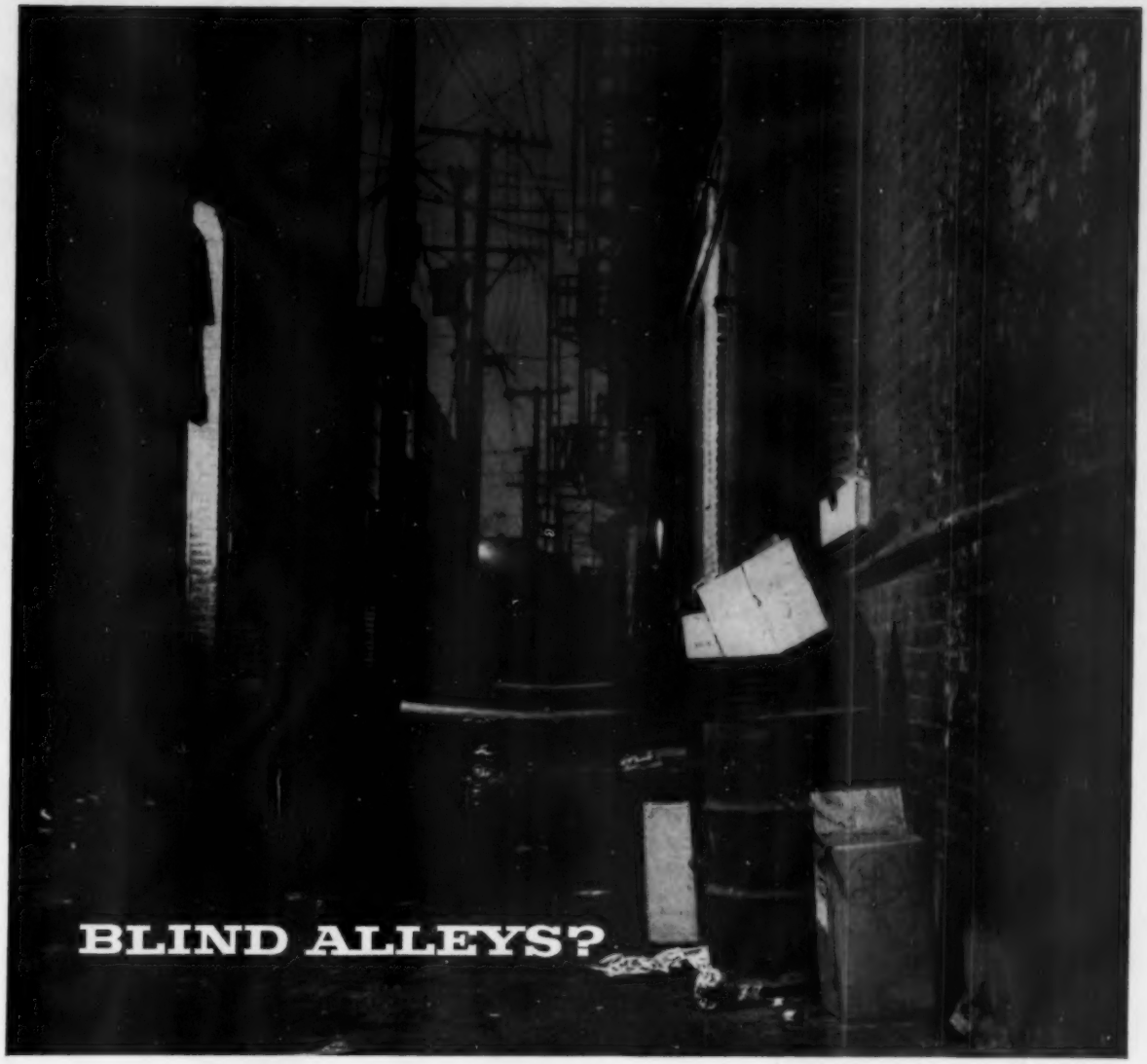

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will solve your hydraulic pump design problems!

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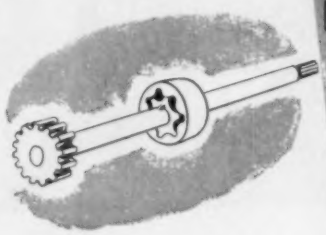

For instance . . . it may be necessary to "wrap" the pump around a "thru" shaft. The unique design of the GEROTOR element (heart of all GEROTOR hydraulic pumps) permits this design feature without sacrifice of space. This is only one example of the many design problem solutions created by GEROTOR engineers.

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A New Addition to the Dempster-Dumpster System of Low Cost Bulk Materials Handling

Now you can have either of two types of Dempster-Dumpsters in the fastest, most efficient and lowest cost method of bulk materials handling ever devised.

IN THIS MODERN, low cost system, one truck-mounted Dempster-Dumpster picks up, hauls and empties, or sets down intact, one loaded detachable Dempster-Dumpster Container after another, regardless of design or size, handling bulk materials of practically every description.

The new Dempster-Dumpster Type DTLF offers several desirable features along with all the economies provided by the Type LFW. These features include: (1) Improved load distribution with container carried in more forward position between wheel centers. (2) Extreme high dumping in cases where it is desired. (3) Vertical pick up of loaded container. (4) Container, loaded or empty, is always in horizontal plane in carrying position. Automatic locking device for positive rigidness of container while in carrying position is, of course, provided.

TREMENDOUS SAVINGS WITH THE DEMPSTER-DUMPSTER SYSTEM HAVE BEEN PROVED BEYOND QUESTION.

One truck-mounted Dempster-Dumpster, operated by only one man, the driver, serves scores of containers of various capacities up to three times greater than the average dump truck. You eliminate trucks standing idle . . . eliminate re-handling of materials . . . eliminate loading crews. You increase efficiency, sanitation and good plant-keeping.

Containers range from 2 to 21 cu. yds. capacity for use with recommended type Dempster-Dumpsters. Each container is designed to suit the materials to be handled—be they trash, rubbish, liquids, dust, bulky, light or heavy. Many leading plants, in almost every type of industry, have found it indispensable after installation. Its proved savings alone justifies an investigation of its potential value in your plant now. Write to us today for complete information. Manufactured and sold exclusively by Dempster Brothers, Inc.

The photo at left illustrates the amazing ability of the Type DTLF Dempster-Dumpster for high dumping. The three photos below show the Pick Up, Haul and Dumping action, hydraulically controlled from cab.

DEMPSTER

Photo above shows the new Dempster-Dumpster Type DTLF dumping 8 cu. yds. of rubbish. At right you see the Type LFW with load in carrying position. Dempster-Dumpsters are available in capacities capable of handling up to 38,000 pound payloads.

One Truck-Mounted
Dempster-Dumpster Handles Scores
of Containers... All Designs... All Sizes

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"American industry . . .
keeps our armed forces the finest equipped in the world . . ."

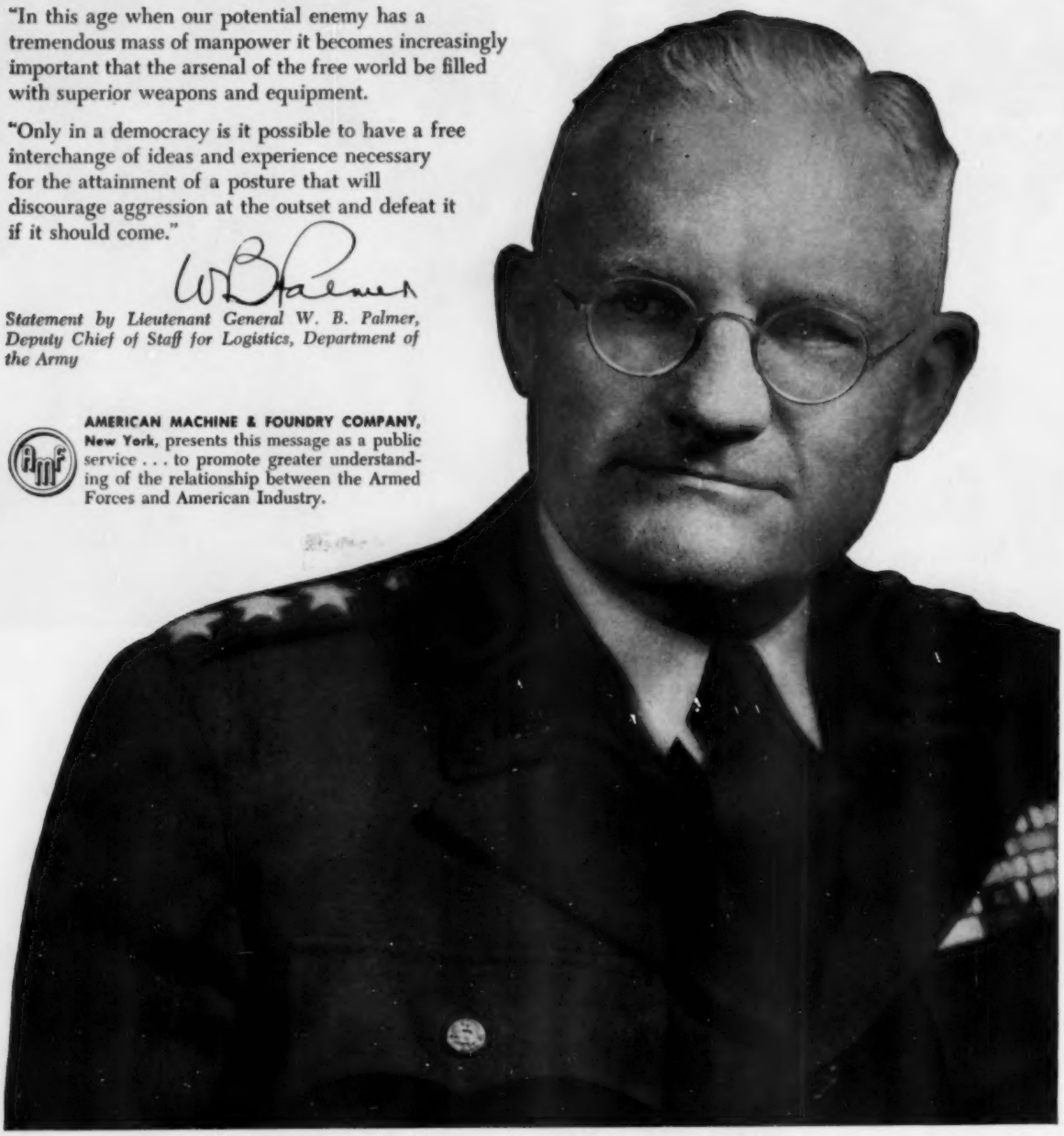
"American industry is contributing immeasurably to the technological development and volume production of modern new weapons that make our armed forces the finest equipped in the world today.

"In this age when our potential enemy has a tremendous mass of manpower it becomes increasingly important that the arsenal of the free world be filled with superior weapons and equipment.

"Only in a democracy is it possible to have a free interchange of ideas and experience necessary for the attainment of a posture that will discourage aggression at the outset and defeat it if it should come."

W. B. Palmer

Statement by Lieutenant General W. B. Palmer, Deputy Chief of Staff for Logistics, Department of the Army



AMERICAN MACHINE & FOUNDRY COMPANY, New York, presents this message as a public service . . . to promote greater understanding of the relationship between the Armed Forces and American Industry.

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"Mr. Cost Cutter" reveals how plant saves money while it improves results

Results achieved by an automotive company tell a story of major improvement in chromium plating operations.

The advantages of the Unichrome SRHS Chromium Plating Solution as pointed out by United Chromium were first checked by this company's critical research division. Shortly thereafter, the SRHS solution replaced the ordinary solution in a fully automatic plating machine.

All benefits were confirmed. Loss by dragout dropped since the solution was more dilute. Loss by spray carried off in the ventilators diminished because the higher efficiency of the SRHS bath reduced the wasteful gassing which causes spray. In fact, records show that consumption of chromium plating salts used to maintain the bath was cut *more than half*. In addition – faster plating speed was obtained; also brighter deposits, and better coverage.

This company now has every chromium plating tank in the plant working with, and saving with, Unichrome SRHS Chromium.

MORE WAYS UNITED CHROMIUM HELPS TO SAVE ON COATING OF METALS

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The first set of matched copper, bright nickel, and chromium plating processes has been developed by United Chromium. Compatability of the processes plus the undivided service responsibility they offer can assure the very finest chromium finishes at a new low cost.

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Unichrome Coating 5300, developed by the Organic Coatings Division of United Chromium, cuts costs for corrosion-proofing tanks, ducts, and other equipment. This sprayable vinyl plastisol produces thick chemical-resisting coatings with advantages over sheet and paint linings built up to comparable thickness.

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United Chromium supplies equipment for complete plating installations. Tanks, rectifiers, heaters, and other Unichrome equipment are, from experience, designed for efficient operation and genuine economy.

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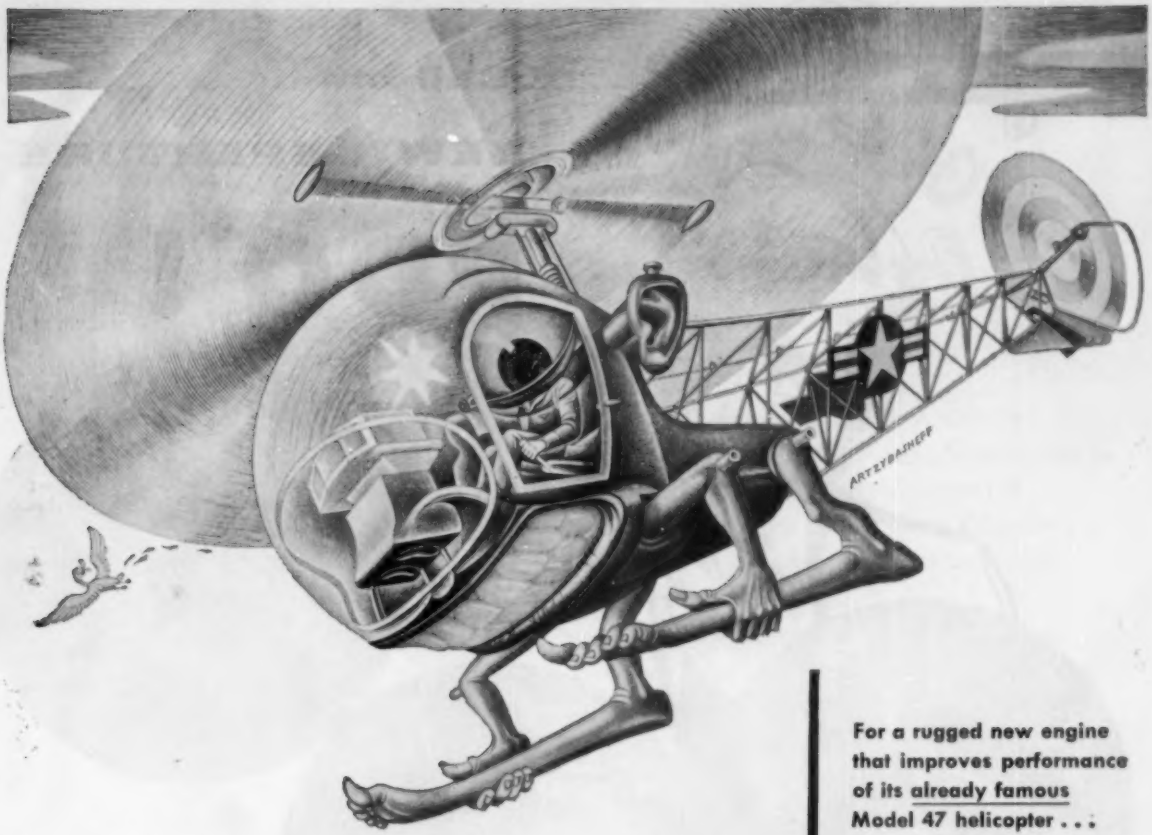

New "vitals" for this Korean air vet

This battle-proven hero of 18,000 front-line rescues over Korea is now *outperforming itself*—newly powered by Lycoming's 250-h.p. O-435 engine.

With this superior power plant, both the Model 47 and its sister ship—the 4-Place Utility 47G-1—will fly faster and higher in all weather . . . and require far less maintenance.

Such performance improvement is but one of many Lycoming contributions to air-cooled power.

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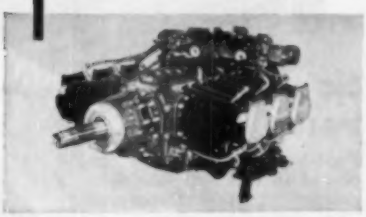
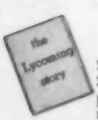
Long-term U.S. Air Force development projects for gas-turbine power plants provide interesting opportunities for engineers experienced in: research, design, test, in-flight development, application engineering, and customer relations. Write Personnel Director, Lycoming Division, Industrial Relations, Stratford, Connecticut.

For a rugged new engine that improves performance of its already famous Model 47 helicopter . . . and reduces maintenance as well . . . BELL looks to Lycoming.





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GUIDE WORDS FOR TODAY

"The sand in the hourglass is running out. The moment of decision between survival of freedom or enslavement under Communism cannot be put off. To try to dodge the responsibility is to favor the enemy.

"Only when the people of your great nation and those of other nations which have already stood side by side in the recent fight against the scourge of the present world — Communism — come to realize that the red menace is a very real threat to their own personal freedoms, can Communism be defeated."

—President SYNGMAN RHEE
Republic of Korea
(in a recorded message dictated July 6, 1954)

Among those who clamor with advice on *how* to fight Communism, *when* to fight Communism, and even *whether* to fight Communism, there are still a few who *have* fought Communism successfully.

Syngman Rhee is such a fighter, and he knows his enemy well. His words are a clear and timely warning to the entire free world.

If the lessons of history are not learned and followed, history itself becomes a time-bomb. And time is short.

W. B. Stewart
PRESIDENT

DUTY HONOR COUNTRY
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The GRAY Manufacturing Company, Hartford 1, Conn.
Audograph and PhonAudograph "Pushbutton Dictation" Equipment

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come to Airtemp

DIVISION OF CHRYSLER

. . . for precision-engineered equipment that meets every requirement best

FOR CONVENTIONAL WINDOWS ▼

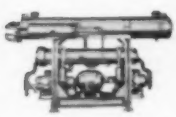
FOR CASEMENT WINDOWS ▶

ROOM AIR CONDITIONERS. *Conventional Window Models* in ½-, ¾- and 1-hp capacities. Ideal for home or office use. Reverse-cycle operation of Custom models provides heat for chilly days. *Casement Window Models* in ½- and ¾-hp. Easy inside installation without cutting or removing glass —nothing projects outside.

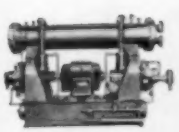
WATERLESS "PACKAGED" AIR CONDITIONERS. In 2-, 3-, 5- and 7½-hp. Use no water, need no plumbing — all-electric operation. "Packaged" model shown is complete with condenser and coil. "Custom" unit with condenser for outdoor or indoor installation.

WATER-COOLED "PACKAGED" AIR CONDITIONERS. 2-, 3-, 5-, 8-, 11- and 15-ton capacities. Cool, dehumidify, filter and circulate air. Free air discharge or duct distribution. Heating coil optional. Compact, space-saving design.

INDIVIDUAL ROOM AIR CONDITIONING UNITS. Used for year 'round heating and cooling by connecting to circulating cold and hot water system. Ideal for hotels, motels, offices. Three types—floor, wall and ceiling. Built-in controls. Two centrifugal fans provide circulation.



"PACKAGED" LIQUID COOLERS. Supply chilled water for refrigerated cooling in central system air conditioning of buildings of all types. For use with Freon 12, sizes 3- to 75-hp. For use with Freon 22, sizes 25- to 125-hp. A completely assembled unit—piped, pressure tested, dehydrated and supplied with a refrigerant holding charge.

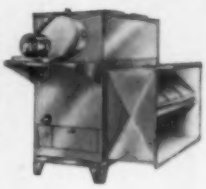


RADIAL COMPRESSOR UNITS. In 10- to 125-hp capacities, these heavy-duty units for use with Freon are especially designed for air conditioning or refrigeration. Radial compressors are direct connected and have force-feed lubrication. Automatic capacity-reduction. Light weight, economical to operate.

CENTRAL PLANT "PACKAGED" AIR CONDITIONERS. Self-contained Central Type "Packaged" Air Conditioners of 25-, 40-, 60- and 100-ton capacities. Utilize the Airtemp Radial Compressor with its exclusive features. Available with evaporative condenser or for use with cooling tower.

EVAPORATIVE CONDENSERS. In sizes from 3- to 100-hp, for either indoor or outdoor application in central type air conditioning systems. Perform function similar to that of water-cooled condenser and cooling tower combination. Sectional construction. Protected inside and out against damaging corrosion.

AIR HANDLING UNITS. These unit air conditioners, in floor and ceiling types, are available in capacities from 1.5-hp to 175-hp for handling air in volumes from 480 to 37,000 cfm. Designed to cool, dehumidify, heat, humidify, filter and circulate air.



COOLING TOWERS. In capacities from 3- to 100-hp. Designed to save up to 95% of the normal water requirement for all types of air conditioning equipment from the simple "packaged" air conditioner to the large central plant system. Adaptable for outdoor use.

Air Conditioning's other name... Chrysler Airtemp

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"As revolutionary as gun powder..." says a military authority of tactical television, latest communications device of the armed services.

In recent tests, pictures of amphibious landings, "prisoner" interviews, aerial reconnaissance were transmitted instantly to command posts by Raytheon's portable KTR-100 microwave relay.

The growing military and commercial uses of the KTR-100—both portable and in fixed locations—demonstrate clearly the versatility and reliability of Raytheon electronic equipment.

RAYTHEON

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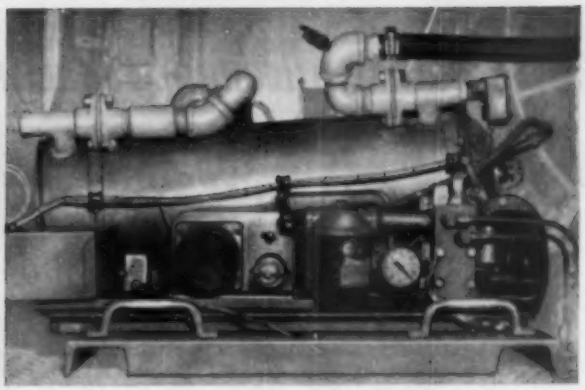


TYPE 0-6 CRASH TRUCK plus JANITROL LIQUID HEATER equals

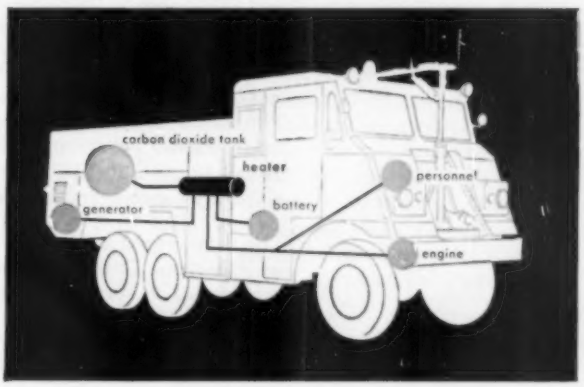
WINTERIZATION TO 65° BELOW ZERO

It takes just fifteen minutes for two men to install and connect, or disconnect and remove the Janitrol Liquid Heater equipped "winterization kit" in the Air Forces new Type 0-6 Cardox Crash Truck.

Cardox engineers took full advantage of Janitrol unit design accessibility . . . added a coolant pump, hand bypass pump, electrical over-ride connections, and an aluminum channel-iron skid base to come up with the ultimate in changeover speed. Just six quick-disconnect couplings tie coolant flow—electric supply—and fuel supply to the permanently installed winterization system within the truck. Operating controls are installed in the truck cab.

The Janitrol heater provides 90,000 Btu/hr for engine block, engine pan, battery box, radiator, cab and body, defrosting, a motor generator set, and the Cardox pressure vessel heating. Complete insurance against winter operating failures caused by freeze-ups!

Look into Janitrol Liquid Heaters' long record of dependability under all conditions—and you'll specify "Janitrol" for vehicle heat wherever and whenever needed.



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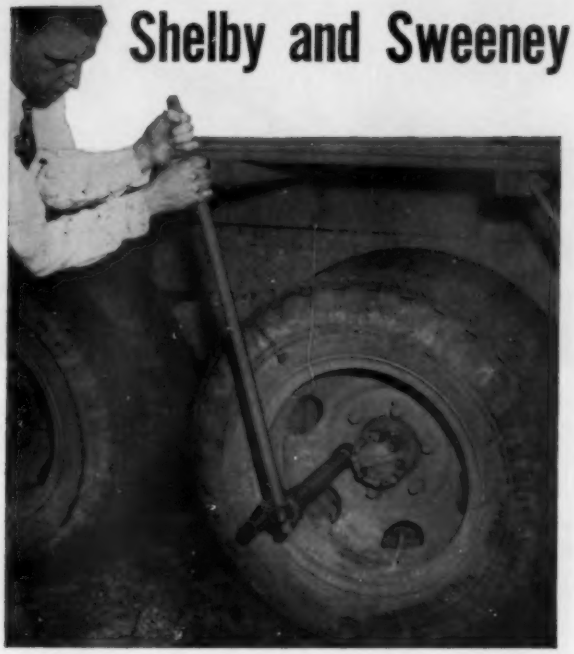

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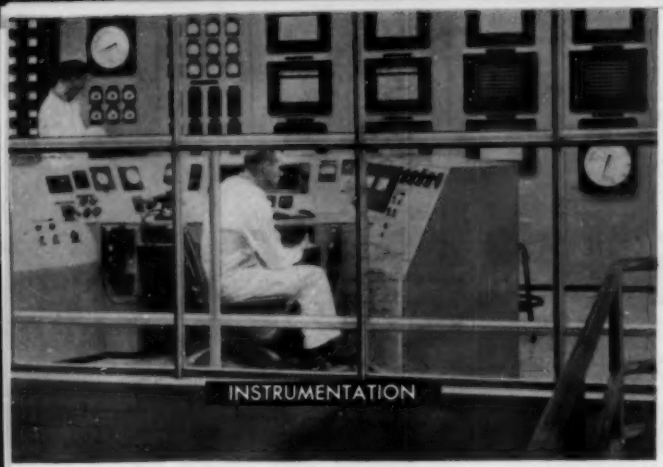
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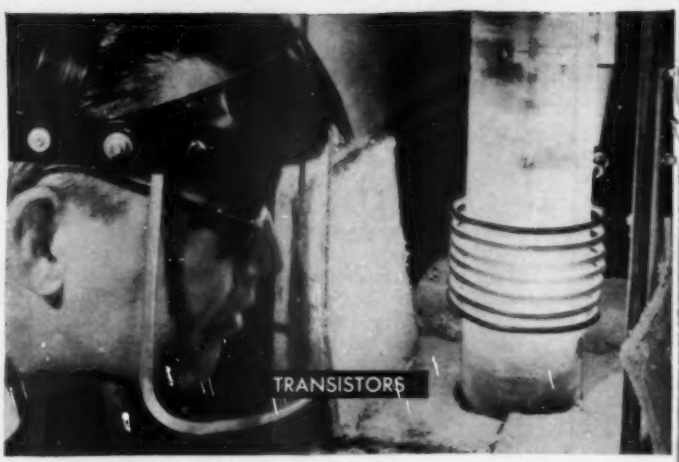
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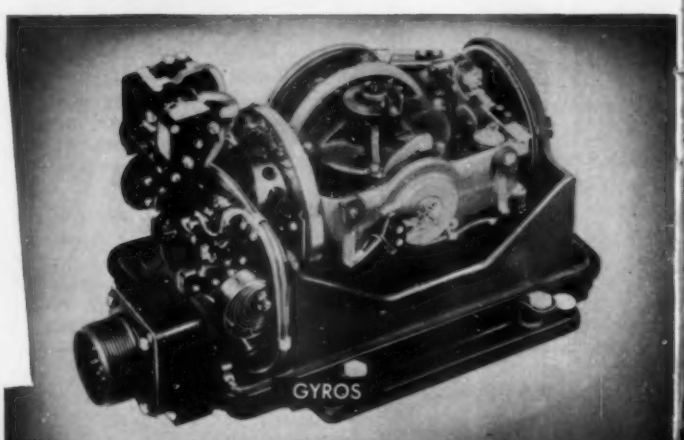
GYROS

ARMAMENT TECHNOLOGY

This section of ORDNANCE contains articles of a detailed and technical nature on ordnance research, development, manufacture, field use, and related subjects.

Nonmagnetic Minesweepers

Specially designed craft counteract the threat of magnetic mines

Comdr. R. L. Karl and Lieut. Comdr. J. H. Thornton, Jr.

Commander Karl is an assistant in the Mine Craft Branch and Commander Thornton is an assistant in the Mine Countermeasurers Branch, both of the Navy Bureau of Ships, Washington, D. C.

BEHIND the actual combat operations of naval mine warfare there continues to be a vital duel between the designer of mines and the naval engineer who creates ships and countermeasures to clear the mines. They fence for huge stakes. If the thrust of the mine designer of an enemy is not quickly parried with an adequate countermeasure of ours, then the Nation is exposed to the mortal danger of having its major ports closed to shipping with alarming speed.

In order to meet this threat, new vessels and new countermeasures have been developed on the drafting boards of various naval facilities and selected private design agencies.

This article will deal with a description of three of the latest types of vessels which have been designed and built to clear enemy mine fields—the "nonmagnetic" AM, AMS, and MSB types.

WORLD War II demonstrated clearly the importance of the mine problem in modern warfare. It showed the effectiveness of new types of mines, particularly of the magnetic type, actuated by the presence of the magnetic field of steel vessels or of wooden vessels with ferromagnetic components.

The appearance of the magnetic mine led to the installation of costly and complex degaussing systems on almost all major combatant and auxiliary vessels employed during World War II.

Later mines, however, were designed with even greater sensitivity to detect magnetic fields not completely neutralized by degaussing. Mines have also been developed which are actuated by the acoustic frequencies of a ship's propulsion sounds or by the change in pressure resulting from the passage of a vessel over the mine or by combinations of the above three influences.

KOREAN operations demonstrated once again the importance of mining in naval warfare. Highly sensitive magnetic mines and numerous moored contact mines were encountered off the coast of Korea. These mines not only threatened the landings of United Nations forces, but also claimed the U. S. minesweepers, PIRATE, PARTRIDGE, PLEDGE, and MAGPIE as victims before they were cleared.

These losses, and the threat to amphibious operations, pointed up the critical need in the U. S. fleets for large numbers of modern minesweepers of as low a magnetic signature as practicable.

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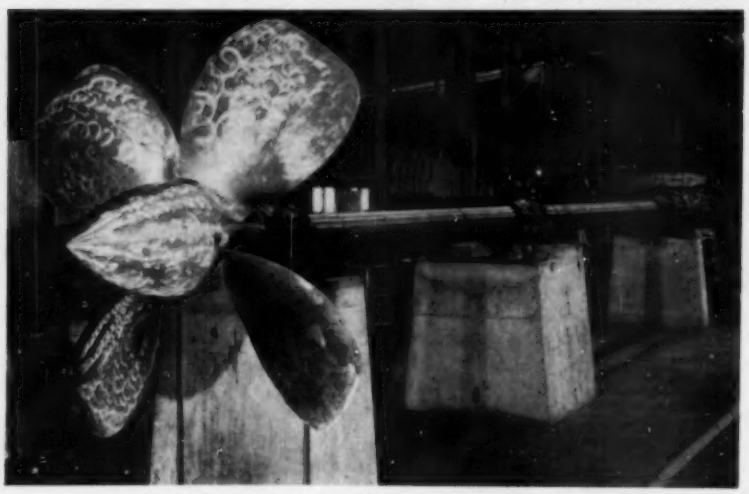
A challenge to Ordnancemen

By making the minesweeper as nonmagnetic as possible, the sweepers could then sweep magnetic mines and detonate them at safe distances from the minesweeper itself. The need for such vessels had been foreseen prior to 1948, but authorization was not forthcoming until Korean operations.

The new minesweeper construction program, once under way, became a major effort which, in some way, affected nearly every activity of the Navy Department's Bureau of Ships and Bureau of Ordnance as well as a great segment of U. S. industry.

Nonmagnetic sweepers of the AM and AMS type were built in considerable quantities, not only for the U. S. Navy but also for many foreign nations under the Mutual Security Program. In addition, Navy minesweeping boats (MSB) and motor launches of very low magnetic signature were, and are, being constructed.



Capable of varying the angle of its blades, the controllable reversible-pitch propeller gives the new minesweepers greater flexibility in speed and direction.

The minesweeper program as authorized to date consists of the construction of 62 AM, 22 AMS, and 49 MSB vessels for the U. S. Navy and 35 AM and 112 AMS types for delivery to foreign nations.

The need for relatively nonmagnetic AM vessels was visualized during 1948-1949. The first important step in their construction was the selection of a material which could be used to build successfully a vessel large enough to supplement or replace the 220-foot, steel-hull AM. Aluminum was seriously considered until tests and study showed this material, though nonmagnetic, was unsatisfactory for this application.

Wood remained the only feasible structural material for the new AM, and this imposed the first serious restriction in the nonmagnetic building program. It tended to limit the size of the new vessels to approximately 165 feet in length. Based on structural experience in wood design prior to 1950, this length was considered limiting.

Other types of problems soon appeared. The immediate one would have given the shipwright of earlier times little concern. It was how to obtain the big, solid, white-oak pieces for sterns, keels, skegs, knees, stern posts, and deck beams in the quantities needed for a building program of this magnitude.

White oak, because of its structural superiority and great durability, had long been the stand by of the shipwright. Today, however, the giant timbers are scarce and were soon found to be in critically short supply. Perhaps one tree in two hundred could supply timbers of the size needed.

As soon as this situation was recognized, the naval engineers in the Bureau of Ships turned to a development in wooden-ship construction which had grown out of a conference of synthetic adhesive manufacturers held in 1942. With typical American resourcefulness, a resin adhesive had been found which proved durable enough to withstand the rigorous requirements of extreme service exposure and stress at sea.

Using this remarkable adhesive, the shipbuilders of the new minesweepers were able to circumvent the need for large white-oak timbers through the utilization of laminated members formed with the plentiful shorter pieces of oak and fir. The use of laminated structural members in this manner is considered by many to be the first major construction to wooden-ship construction in many years.

WHEN the lead shipbuilder for the AM421 class found he was unable to procure laminated oak in time to meet his erection schedule, he set out to make his own frames. He was extremely successful and demonstrated that shipyards could be permitted to manufacture their own laminated members. Therefore, authority for the various shipyards to make their own laminations, subject to strict quality control, was granted by the Bureau of Ships.

The second major problem was the design and development of nonmagnetic equipment and components to replace virtually every item aboard ship which would normally contain iron and therefore contribute to the magnetic signature of the ship. Here the nearly insurmountable obstacle proved to be the design and construction of nonmagnetic Diesel main engines and auxiliaries.

THE task fell to the Packard Motor Car Company and General Motors Corporation to design and build main engines and generator prime movers using nonmagnetic metallic materials. It will be immediately apparent to engineers that the nonmagnetic requirement is a radical departure from conventional Diesel-engine design and poses a multitude of metallurgical and engineering problems.

The Packard engines first considered were attractive for this application since aluminum was used in considerable quantity where cast iron or steel was more commonly employed.

By redesign, Packard was able to reduce the magnetic characteristics of these engines by using bronzes in place of steel where aluminum was not suitable. Highly stressed parts, such as crankshafts and connecting rods, were fabricated using nitrided stainless steels and nonmagnetic nickel alloys.

The unique all-wood laminated structure of the nonmagnetic minesweeper is clearly visible as a skilled shipwright works on the keel of the AM-422.

As might be expected in any such new design effort, some engineering difficulties have arisen with several of these innovations. Further developments of these engines are the subject of continuing efforts by topflight Diesel and metallurgical engineers. The evolution of the engines alone is a long story of tireless effort, design study, experimentation, and test-stand trials.

Packard produced two major units in the AM, AMS, and MSB classes—the Packard 12-cylinder V engine with a continuous-duty rating of 600 brake horsepower and the Packard 6-cylinder in-line engine with a continuous-duty rating of 300 brake horsepower.

Four Packard 12-cylinder Diesel engines will serve as the main machinery plant in sixty-one AM vessels at the completion of the present program. In addition, the Packard 12-cylinder engines serve as the main engines in two of the AMS-class vessels.

These Diesels also serve as prime movers for electric generators along with the 6-cylinder Packard for use with smaller units. Two 6-cylinder Packard engines each power the forty-nine minesweep boats (MSB).

General Motors Corporation was awarded contracts for the main engines for 132 AMS vessels with some 39 sets of main engines for the AM-class vessels. These engines are modifications of the standard GM 8-278A and 8-268A Diesel engines with essentially only a substitution of nonmagnetic materials for the bulk of the standard magnetic engine parts.

In the AMS vessels powered by General Motors the main engines are two nonmagnetic GM 8-268A's. Each engine is rated at 440 horsepower, drives the propeller through Farrell-Birmingham reduction gears, and is equipped with air clutches and reverse gear.

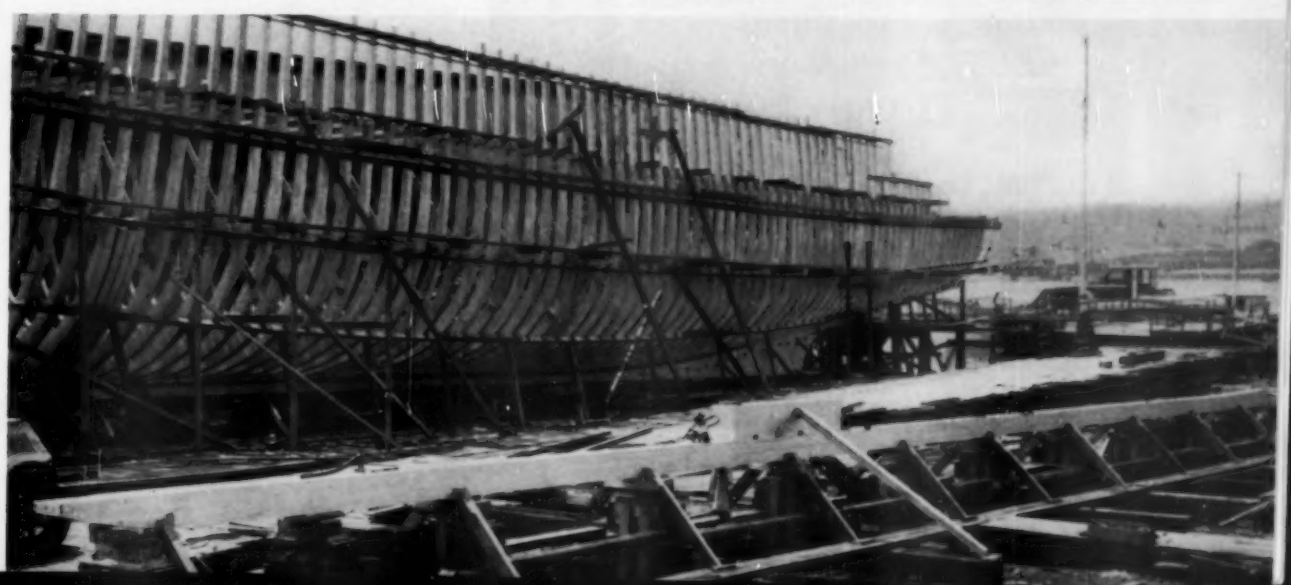
Engine operation is controlled from the pilothouse by Westinghouse pneumatic controls. In the AM vessels having the General Motors installation, two GM 8-278A's serve as the main engines.

GREAT strides have been made in improving ship maneuverability in the 165-foot AM class. In conventional ship design, fixed-pitch, single-piece propellers are used. However, in these new AM's, controllable reversible-pitch propellers are employed. This results in improved maneuverability because of the rapid response to changes of pitch for reversal. It also permits continuous operation of the main engines at their most efficient speed while affording great flexibility in ship speed and direction.

The controllable-pitch propeller is particularly valuable in improving propulsive efficiency while towing minesweeping gear. Maneuvering of the ship with the engines can be effected either in the pilothouse or in the engine room.

In addition to the innovation of using practically all nonmagnetic materials for components where heretofore ordinary medium carbon and alloy steels were used, many additional features had to be included, such as automatic degaussing compensations for changes in course and the breaking up of piping

Keel for still another nonmagnetic sweeper lies beside partially completed wooden hull as building program reaches height.



	AM 421 Class	*AMS 60 Class*	*MSB 5 Class*
Length over all	173′	144′	57′, 3″
Beam	35′	26′, 10″	15′, 4″
Depth	22′, 6″	13′, 4″	7′
Draft	10′, 4″	8′, 6″	5′
Displacement, normal (tons)	780	384	42
Diesel oil capacity (tons)	44	27	16
Potable water (tons)	14.5	8.6	0.1

Principal characteristics of the new nonmagnetic minesweepers.

systems, life lines, stays, and other equipment comprising closed-loop systems by the use of electrical insulators to avoid setting up eddy currents.

The large Badger distillation plant, cyclotherm heating boilers, and Hyde hydraulic steering gear are of virtually nonmagnetic construction. In addition, main shafting, propellers, galley equipment, piping, plumbing fixtures, anchor chains, and anchors are of nonmagnetic material. Where food is stored in the usual ferromagnetic containers, special degaussing coils have been installed to encircle these areas.

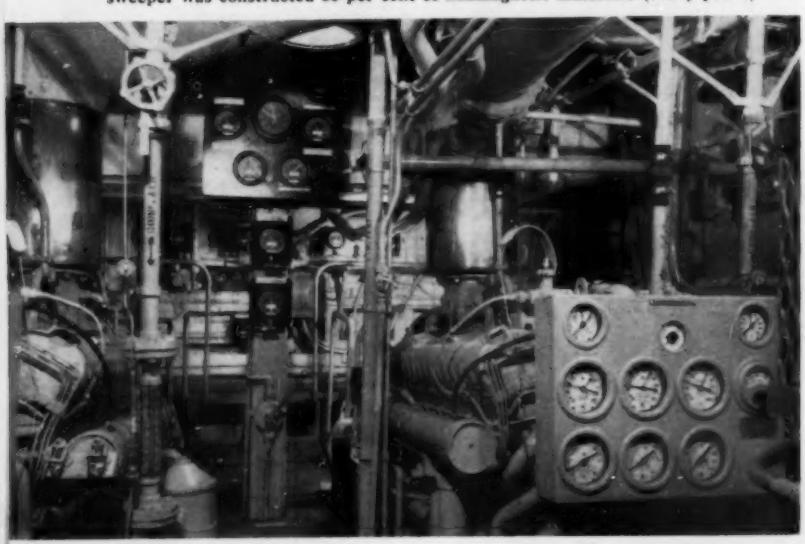
SIMILARLY, refrigeration systems, mufflers, heavy gears, and the cast-bronze rudders are nonmagnetic. Wiring is sheathed in woven nonmagnetic flexible tubing.

Nonmagnetic wire ropes, floats, cutters, and the special equipment associated with minesweeping have been designed, developed, and furnished. Special attention has been given to the minesweeping gear itself. The latest nonmagnetic gear has been installed, a broad stern designed to facilitate the handling of sweep gear, and special trials are in progress to determine the best arrangement for streaming the gear. These matters are of paramount importance as the sweeping of mines is the primary mission of these ships.

Habitability also has received its share of attention, although the limited size of the vessel permits no elaborate luxury features. Each bunk in the crew's berthing space has an individual reading light. Fluorescent lighting has been installed generally throughout the messing and berthing spaces, and ventilation to the maximum practicable extent has been provided.

Efficient working space and comfortable living quarters for the crew insure safer operation, heightened morale, and the more certain accomplishment of each mission.

By careful redesign, machinery in the engine room of this AM-type minesweeper was constructed 80 per cent of nonmagnetic materials (Navy photo).



The tremendously ambitious AM, AMS, and MSB building program, now past its midway mark, has been a major challenge to many of the Nation's leading engineering firms since it entailed solving the numerous problems mentioned.

Perhaps the greatest challenge was presented to the design agents of the vessels, P. L. Rhodes Company of New York for the AM classes, Sparkman and Stevens of New York for the AMS classes, and John Trumpy and Son of Annapolis, Md., for MSB's.

These naval architects, working at first from only meager contract plans, developed the detailed layout of these ships. These men, working under the heavy pressure of early deadlines, must develop a ship in detail to function as a workable operating unit. This entails the preparation of thousands of construction plans and the resolution of an endless number of conflicting requirements.

The new minesweepers are welcome additions to the U. S. Navy. They represent a big step toward meeting the threat of all-out enemy mining activity, although a far larger quantity of minesweeping vessels will likely be needed for U. S. defense as well as for assault sweeping in forward areas.

IN addition to the design and construction of these new vessels the Bureau of Ships continues to emphasize the need for further research and experimentation pointed toward solving the problem of the modern mine. The U. S. Navy Mine Countermeasures Station at Panama City, Fla., is the principal Bureau of Ships activity constantly working on the development of mine countermeasures. It is a vigorous, expanding activity with a very real responsibility to the Nation to develop means for countering enemy mines.

In addition, there are also various universities and contractors which have been engaged by the Bureau of Ships in its efforts to search out the very best scientific and engineering brains to counter the skill of the designers of enemy mines.

With new ships and the latest countermeasures the U. S. Navy is constantly endeavoring to insure that our harbors will remain open to vital shipping in time of national emergency.

Better Truck Tires

Performance, design, and synthetic-rubber content of tires for our military vehicles have been increased many times over those achieved by the armed forces and industry during World War II

Willard D. England

THROUGH the active coöperation of the tire industry definite improvement in performance, design, and increased synthetic content in military tires has been achieved over military tires as we knew them at the end of World War II.

First, the durability of military tires has been improved materially through improved carcass strength and improved compounding in synthetic treads. Owing to the short supply of rayon, cotton cord was acceptable in military tire construction, even in large tires, during the World War II program. Cotton-cord construction in today's military tire production is permitted only in 15- and 16-inch tires for light trucks and, at the option of the manufacturer, in size 7.50x20, 8-ply rating tires. However, almost one hundred per cent of these sizes being furnished are of rayon construction, which insures greater carcass strength. The carcass strength of these tires of rayon construction not only greatly exceeds that of similar tires used in World War II, but it even surpasses without question the increased plunger value set up for these tire sizes over the requirements for World War II tires.

THE use of rayon in carcass construction permits a reduction in number of plies used, increases carcass strength, and raises the uniformity level for tire durability and tire life.

The use of rayon cord provides a more flexible carcass construction, which permits operation at lower inflations as used in sand and cross-country operation, for maximum flotation ability without fear of cord fatigue failures. Since the growth of rayon due to service is more controllable and uniform than that of cotton, synthetic treads gain more resistance to cutting and cracking.

Both were widespread causes for tire failure in World War II.

The use of improved rayon cord in carcass construction has reduced tire operating temperature, thus giving greater resistance to synthetic tread separation and heat-break failure formerly associated with tires having cotton and synthetic construction.

Despite the increased and ever-increasing load and speed demands on these tires brought about by heavier and faster military vehicles with increased payload capacities, these gains in carcass strength (through improved cord construction) are apparent in the doubled life expectancy of the present military tires over their World War II counterparts.

Nylon cord may soon become available in sufficient quantities to permit its use in the immediate and future production of military tires for transport service. As rayon cord proved a boon to synthetic construction in military tires over cotton construction, nylon, with its recognized approximate double strength of rayon, can advance us one step nearer to our desired achievement of maximum synthetic content in military tires.

Mr. England is chief of the Rubber Branch, Research and Development Division, Detroit Arsenal, Center Line, Mich.

BUT just as the advancement in quality of rayon cord to its present accepted high position as a fabric for tire carcass construction took a period of years to develop, so we can expect the widespread use of nylon as a tire cord to require development over a period of years.

The greatest factor in restricting the use of nylon cord in tire construction is the fact that its stretch characteristics are entirely different from those of rayon.

To utilize the strength to be gained with nylon, the first problem to be overcome is that of restricting the nylon carcass growth which imposes growth strains on the tread and lowers tread resistance to cutting, cracking, and separation. Satisfactory progress can be reported in this respect through the prestretching methods being developed by various manufacturers of military truck tires.

Durability tests of 9.00 and 11.00x20 nylon-cord military tires indicate that these prestretching methods are definitely improving the durability of nylon cord tires to the extent that we believe nylon could be considered as a suitable and effective tire fabric in the not-so-distant future.

The development and the satisfactory use of nylon as a tire cord for carcass

construction will bring us one step nearer our goal by increasing carcass strength, further reducing tire operating temperature, and increasing the resistance of synthetic treads to their prime enemy—heat.

"HOT" GR-S (Buna S) was the type of synthetic rubber developed during World War II and used by all manufacturers in tire construction. During the past few years, the number of standard, special, and experimental types of GR-S manufactured and distributed has increased substantially. One most significant development has been "cold rubber" (GR-S polymerized at 41 degrees Fahrenheit).

Cold rubber has been compounded and recompounded to the point where the synthetic we are receiving in military tires today is a vast improvement over the hot-type GR-S used in World War II because of its resistance to cracking, tearing, chipping, outgrowth, tread wear, and its over-all performance.

It is safe to say that, through this development of the original GR-S synthetic rubber, the synthetic polymers being put into tires today have, in every respect, improved durability over the World War II military tire.

Although the military tire still retains the nondirectional-type tread design, which affords maximum traction in either forward or reverse, changes have been made from what was formerly called an NDMS (nondirectional mud and snow) tire to our present NDCC (nondirectional cross country) tire. In the NDCC, the sharp corner has been eliminated at the edge of the tread over the shoulder of the tire, thus achieving a more rounded tread profile.

This elimination of excess tread rubber in the shoulder region accomplished two purposes. First, the tire was made more flexible and thereby its flotation performance was improved. Secondly, the failure resistance was increased.

Tread separation brought about by extreme operating temperatures was one of the major reasons for tire removal during World War II. This tread separation usually developed under the tread lugs in the shoulder area. Operating temperatures in this area were reduced by changing to the NDCC design.

Further design changes in tread appearance are being investigated for the purpose of increasing the resistance to irregular wear, a phenomenon common to front tires. This type of wear is known as "heel-and-toe" and is aggravated by the front-end geometry settings (camber and toe-in) of the vehicle.

Proposed changes in design should give more stability to the tread lugs in the shoulder area, thereby giving the tire more resistance to irregular wear. Moreover, eliminating excess rubber in the shoulder area, especially in the voids, should give the tires more ability to dissipate heat in this critical region.

The actual synthetic content of tires presently being purchased for military vehicles does not show any large increase over the synthetic content of tires of like sizes of World War II vintage. But a comparison of the two shows that the military tire of today has been developed through improved synthetic polymers to the point where, in spite of the heavier payloads, higher speeds, and heavier vehicles, double durability and service life can be expected.

At this time and in an emergency, tires could be made that would have a higher synthetic content than that of their World War II counterparts; but under the more rigid and severe test conditions set up for the qualification and acceptance of today's product, they would be superior to World War II tires, which had a lower synthetic content.

Depending on size, the present military tires (up to and including 9.00x20, 8-ply rating) contain from 87 to 97.5 per cent synthetic, which is the maximum synthetic content that can be incorporated without affecting the high degree of durability developed in these tires. Transport tires (from 9.00x20, 10-ply rating, up to and including 14.00x 20, 12-ply rating) contain 60 per cent synthetic.

Rocks and ledges supply the necessary conditions to test synthetic military tires for susceptibility to bruise breaks at Detroit Arsenal (Army photo).

DEVELOPMENT and testing of synthetic tires in these sizes have shown that, in an emergency, these sizes could be stepped up to eighty-seven per cent synthetic with satisfactory results. At present, some loss in over-all durability can be expected where extremely high atmospheric temperatures are coupled with high sustained speeds under maximum payload conditions.

It is not improbable that, with the development of nylon cord as a carcass fabric and with the proposed changes in design, a satisfactory 87 per cent synthetic tire could be produced in sizes from 9.00x20, 10-ply, through 14.00x20, 12-ply, with no loss of durability. Synthetic rubber is being incorporated in increasing amounts in tires of larger cross section for use in off-the-road service.

IT is expected that the increased resistance to cutting, cracking, and chipping (developed in synthetic tire treads through compounding) will allow synthetic content in large proportions in the larger-sized tires which, up until now, have contained no synthetic rubber.

Judging from test results obtained in numerous programs at Camp Bullis, it appears that the increase in carcass strength developed through improved cord tensile strength and improved methods of carcass construction will

Synthetic-rubber tires are tested for fabric weakness by actual driving over solid rock ledges as part of Detroit Arsenal's research program (Army photo).

allow the elimination of the 9.00x20, 10-ply, dual-bead NDMS tires from our standardization program list. This tire will be replaced with the standard 9.00x 20, 8-ply, single-bead NDCC tires developed since World War II.

The increased strength of these lighter tires, used primarily on 2½-ton vehicles, makes them practical for satisfactory performance under conditions of load for the 4-ton Diamond T vehicle, which has been equipped with the 9.00x20, 10-ply, NDMS tires.

THE problem of rubber deterioration and how to interpret its effect on the serviceability of rubber end items was of such serious proportions as to cause a joint meeting of the Department of Defense, the National Research Council, and industry on September 29, 1953. This meeting was marked principally by the lack of fundamental knowledge on the subject. Since World War II, the Rock Island Arsenal has been conducting extensive basic research for Army Ordnance. In addition to this basic research, Detroit Arsenal has, through one laboratory contract, developed several other possible chemical additives for rubber which promise effective long-range protection against one type of deterioration—ozone attack.

Five other contracts are in effect to adapt the developments of the Rock Island Arsenal and the Detroit Arsenal laboratory to actual practical tire and mechanical goods production. Experimental weather-resistant tires have been exposed outdoors in five sites (located between Yuma, Ariz., and Alaska), and some of the constructions are crack-free after eighteen months. Presently procured tires last less than one week under the same conditions.

We believe there is a much better solution to the problem than the various paints and compounds now being used in quantity in tire storage. Information also is being collected on the storage life of rubber items under various conditions. It should be pointed out that rubber is essentially a perishable item under any known method of preservation, and such deterioration can be slowed down only to some extent.

The Detroit Arsenal also has conducted tests on arctic performance of tires, tubes, valve cores, caps, and so on, and has found commercial items to be adequate in certain cases. Continued research and development and specification revision on these problems are under way. In some cases, the commercial companies are improving and testing new developments at their own expense, and other developments are being carried out under ordnance contracts.

We are still striving to make it possible technically to manufacture tires from materials available within the continental United States. Two contracts are under way to replace natural rubber cements with synthetic cements in tire building. One small contract involves a preliminary investigation into premature tire failures developed under certain test-wheel and superhighway conditions.

Two contracts are under way to develop lightweight wheels which meet the specifications of the wheel standardization program of the Department of Defense.

Under another contract all known or published data on the low-temperature properties of the various rubber polymers will be accumulated and tabulated in one report for ready use.

THE central inflation system for tires, which allows the driver to adjust tire inflations to the terrain without leaving his seat, demonstrated its full potentialities in World War II, particularly in the 2½-ton DUKW amphibious truck. Detroit Arsenal entered into a contract with the original designers, A. Schrader Son, to develop a completely automatic system improving all known limitations of the World War II system. We are currently in a program to incorporate a pilot system in the newly designed amphibious vehicles.

Steep grades, causing shifting of loads and a tremendous strain on tire carcasses, are a part of the military tire test conditions at Detroit (Army photo).

Fungus Control

The rapid deterioration of electronic equipment when exposed to mold indicates the need for the use of resistant materials and better construction to insure reliability in combat and storage

Louis A. Greenhood

MILITARY electronics equipment must be ready to operate at the turn of a switch or the push a button—it is of no use to anybody when it is inoperative. This obvious fact was driven home in dramatic fashion in the early years of World War II when we were engaged with the Japanese in the South Pacific. Our well-built, well-designed electronic gear went to pieces; sometimes, it seemed, in a matter of hours.

Our experiences in 1942 caused an immediate reëvaluation, in a logistics sense, of our entire approach to the design and packaging of equipment. We had come upon an unforeseen and apparently unconquerable enemy.

That enemy was deterioration. Call it rot, mildew, or fungus, it destroyed equipment faster than we could produce it. Overnight, it made obsolete most of the established insulating materials in common use at that time. A quick fix was necessary—a stopgap—then the problem could be attacked in an orderly fashion in the laboratories.

THE quick fix was found. It had then and still has its limitations, but with modifications it is in use today. Both military and civilian research laboratories have developed better methods, but the fact remains that the electronics industry, by and large, has not adopted these methods.

Why it has not depends, in large part, on a misunderstanding of the nature of the problem. Parenthetically, it should be said that the industry is not entirely to blame for this. After all, only the largest producers can maintain extensive research and development programs, and even they do not always have the services of mycologists or bacteriologists.

Moreover, the military believed, and industry concurred with them, that the problem was purely a tropical one.

In peacetime, before 1942, the services had very little electronic equipment, and the little they had was under constant preventive maintenance so that deterioration in unmolested storage could not be evaluated. Similarly, the radio industry had no storage problem, since a new commercial line was designed every year, and the product was made one day and sold the next.

When we went to war, all that changed. When electronics equipment started to fall apart in the Pacific theater, something had to be done—protection had to be devised. The obvious thing to do was to coat everything which could be attacked by fungus with a fungicide in a suitable vehicle.

The first vehicle tried was shellac, then in common use in the industry; it could be loaded with fungicide and was easy to apply. Then the trouble started. Long before the equipment ever reached the field, the fungicide had leached out, and the organic base of the lacquer provided an excellent culture medium for the growth of mold.

NEXT, a varnish using a relatively inert resin in a tung-oil vehicle with salicylanilide for a fungicide was tried. This proved to be somewhat satisfactory and is still in general use today. However, there are several shortcomings with this method. Here are a few of them:

1. Salicylanilide is an effective fungicide against only a limited number of types of parasitic organisms. The varnish itself, because of its inertness, provides the greater protection.

2. Application is difficult. The equipment must be heated and dried for a long period of time prior to the application of the varnish, and the finish developed after varnishing must be carefully inspected, since pinholes are enough to permit certain fungi to grow under it.

3. This type of treatment is so expensive that only equipment destined for tropical storage and use is so treated. But the crux of the problem is in the fact that fungi exist everywhere. The air you are now breathing is certain to contain at least one hundred spores of one or more of the more common fungi per cubic foot. Under proper conditions each spore is capable of starting a mold colony, and the proper

Mr. Greenhood has worked on the problems of fungus control with Strasburger and Siegel, chemists and bacteriologists, Baltimore, Md. He was formerly in the engineering department of the Glenn L. Martin Company.

conditions can exist from the equator to the poles.

To grow fungi, the following are necessary: a nutrient surface, high relative humidity, and a sufficient periodic variation of temperature to cause the formation of dew. These three conditions will suffice over a range of temperatures from 20 to 130 degrees Fahrenheit to grow most organisms.

Subjected to these conditions, electronic equipment will deteriorate in the same fashion in a warehouse in New York as in the jungles of Panama, although not so rapidly.

Of the more than 100,000 identified species of fungi, less than 5,000 types do most of the damage to equipment and supplies. Oddly enough, among the chief offenders are members of the *Penicillium* group, famous for their antibiotic uses, and certain subgroupings of *Trichoderma sporata,* whose family contains the microörganisms that aid in the ripening of Camembert, Liederkranz, and similar cheeses.

SOME yeasts, close relatives to the ones the brewers and bakers use, also cause considerable trouble by digesting adhesives and sizings made from carbohydrate substances.

To complicate the control problem further, the organisms doing the greatest damage are among the commonest and are found in quantity all over the surface of the globe.

In the search for an effective fungus-control medium, let us consider the concept of a fungicidal protective coating. As long as that coating remains intact, there is a degree of protection against some organisms. The military specification, MIL-V-173A, governing the properties of such a coating, provides standards of toxicity against four organisms, two of the *Aspergillus* group, *Penicillium luteum,* and *Trichoderma* T-1.

Yet the Office of Scientific Research and Development in Washington, D.C., maintains a file of over 4,500 different fungus cultures developed in connection with its research into the causes of deterioration of optical equipment, plastics, textiles, and photographic supplies.

Obviously, control over four organisms out of a multitude is not enough. Moreover, the fungicidal coating cannot be used in tube sockets, cable connectors, and other disconnect areas where entrapment of moisture occurs and fungi could be grown. Other forms of fungus control must be found—control that is effective in every conceivable situation.

"Every one concerned with the present military program knows we do not have resources to waste on the altar of unnecessary attrition. But the argument of cost is two-edged—the expensive undertaking of fungus control would be truly offset by the tremendous savings possible."

Dr. Glenn T. Greathouse, director of the National Research Council's Tropical Deterioration Center, has frequently commented on the enormous scope of the problem. Speaking before an audience composed of members of the American Institute of Optical Engineers and others in Washington in 1945, Dr. Greathouse said:

"The total cost of optical and photographic equipment, as well as other material of the greatest tactical importance destroyed or severely damaged as a result of microörganic growths, or from the by-products of such growths . . . exceeded the cost of all the small-arms ammunition expended in the South Pacific theater of operations during the first two years of the war."

RECENTLY the University of Pennsylvania completed an extensive research program under government contract. The Engineering Center at Fort Belvoir, Va.; Squier Signal Laboratory at Fort Monmouth, N.J.; Air Research and Development Command at its base at Rome, N.Y.; Pitman-Dunn Laboratory at Frankford Arsenal in Philadelphia, Pa.; and the Naval Research Laboratory in Washington, D.C., are maintaining a continuing program of investigation for their respective services.

Harvard Medical School has one of the largest files of mycological cultures in the world. The University of Florida has an engineering and industrial experimental station which has made valuable contributions in the development of fungicides and techniques.

In the solution of individual problems, dramatic successes have been obtained by these programs, but thus far no criteria to be used by all industry have been put forth.

From all indications, it is up to the electronics industry itself to find its own solution. It must utilize the data developed by all avenues of research and, from its own experience, determine which of the materials, components, and processes adaptable to its uses will support the growth of fungus and which ones are naturally inert.

This imposes a tremendous burden on those engineers responsible for the control of materials, standards, and processes. Nor can they do the job without enlisting the services of experienced mycologists who, in turn, must understand the electrical exigencies which need to be taken into account before anything resembling a solution can be obtained.

Close liason between industry and the interested governmental agencies, in the spirit of continuing coöperation, would be an invaluable ingredient in the success of such a program.

LET us examine some of the factors affecting the development of a sound program. It is not enough, for instance, to know that a material, such as a metal, is not a fungus nutrient, *per se.* The degree of fineness of surface finish must be controlled—otherwise organic dust might collect, become impregnated with moisture, and nurture harmful fungus growths whose by-products, such as enzymes or acids, have been known to damage nonnutrient materials like metals and optical glass.

Another avenue of investigation to be explored is the chemical composition of all nonmetallic materials. An example could be quoted to illustrate its importance. In recent tests at the Pitman-Dunn Laboratory it was found that fungus attacked one sample of polyvinyl chloride film under test and none of the others being tested simultaneously.

This material is one widely used as an insulator on wires and is inert to nearly all fungus growths. However, the plasticizer used in the offending sample was dibutyl sebacate, highly susceptible to the fungus, *Trichoderma sporata,* a common soil contaminant.

Physically and electrically, this composition of polyvinyl chloride is no different from types using inert plasticizers. When it is learned that this is not

a unique, isolated example but a typical problem encountered by the research laboratories, the importance of rigid material specification and control is clearly manifest.

IT would be logical to believe that these problems can be solved only if industry adopts the methods and criteria indicated by the research agencies into a coördinated program of action. Such a program might include the following practices:

1. The elimination of all proteins, protein compounds and derivatives, and such materials as wood, casein and gelatin glues, cotton, linen, paper, cork, leather, felt, hair, and other animal fibers, even as fillers in nonnutrient materials.

2. Every material and component part selected for use should be subjected to a 30-day test sealed in a container with an environment containing a high concentration of spores from many types of fungi, and considerable organic material in small particles, at 95 per cent relative humidity and a temperature of 90 degrees Fahrenheit. The containers should be periodically agitated and cycled through a temperature range from 50 to 120 degrees Fahrenheit throughout the entire test period. In this fashion, the worst possible storage conditions could be simulated.

3. The damage, or resistance to it, should be evaluated by the following criteria:

a. Visual inspection under magnification for fungus growth. If growth is encountered, a determination of type should be made.

b. Chemical damage by the by-products of fungus growth on the part or on the surrounding organic matter should be investigated. If any is found, its composition should be analyzed.

c. Tests should be made to determine any change in the physical or electrical properties of the material as a result of its being subjected to the environment.

d. Measurement of the losses suffered by component materials in the samples as a result of fungus damage could be determined by the use of radioactive tracer elements in resins, plasticizers, fillers, stabilizers, finishes, etc., in accordance with established laboratory practices.

WHEN the procedures outlined above have been followed and the fungus-nutrient materials have been eliminated, the first part of the problem has been brought under control and, at the same time, the need for fungicidal varnish treatment is eliminated.

In the case of large production runs, the cost of the investigative program outlined above would be more than offset by the saving of time, labor, and materials. However, to achieve maximum effectiveness in fungus control, present-day design, packaging, and storage procedures also should be reviewed.

Much has been written in recent years concerning design practices. The problem has been considered from the viewpoints of those engineers concerned with serviceability, radio noise control, interchangeability, flexibility through modular construction, and others.

Yet, although these and other aspects of the working environment for electronic equipment have come in for their share of attention, the establishment of design factors to mitigate the hazard of fungus infection has not.

This problem cannot be attacked in the straightforward fashion indicated for material control. Nevertheless, if those conditions controlling the establishment of fungus colonies—variation in temperature, relative humidity, and the presence of organic material—are used as a starting point, much will suggest itself.

FOR instance, in reducing the probability of sufficient temperature variation to induce dew formation, one thing to be tried is the installation of thermostatically controlled heaters to prevent extreme reduction of temperature when the equipment is inoperative.

Following the same trend of thought toward controlling other environmental aspects favorable to fungus growth, certain rather obvious things can be done. The placement of component parts within an electronic chassis should be carried out with an eye toward the elimination of large horizontal surfaces which tend to collect organic dust.

In addition, the forced-draft cooling systems frequently incorporated in equipment design should produce an air stream of sufficient velocity to prevent the settling of dust on those horizontal surfaces that remain.

In equipment where temperature control through heating and cooling is not practicable and dew formation cannot be prevented, all moisture traps should be eliminated. Drain holes should be provided, and chassis and racks should be channeled so that moisture runoff would be efficient.

ONE area where a tremendous amount of fungus-induced deterioration occurs is in depot storage. Preventive maintenance is difficult and expensive there, even when it can be done at all. It is here that ingenuity in preparation and packing would pay great dividends in the saving of matériel and labor. For example, the following procedure might be explored:

In packing for depot storage, equipment might be heated in drying ovens for a long enough period of time to remove all traces of moisture and to destroy any fungus spores present on it. Immediately following this treatment, the equipment should be encased in pliofilm bags which should then be shrunken to the contour of the material they enclose.

As a further precaution, the surface composition of the pliofilm might include a fungicide, such as calcium propionate or salicylanilide. In the consideration of film materials, latex-base cocooning should not be used since this material deteriorates readily under fungus attack.

The use of carbon dioxide as a fungicide might will be explored by electronics equipment manufacturers. An atmosphere containing 50 to 75 per cent of this gas is usually fatal to all the common fungi. Since it is not only fungicidal but fire-retarding as well, it is worth investigating for use in storage containers and for hermetically sealed devices, at least where metallic corrosion as a result of acid formation through the use of the gas is not important.

AS a concluding argument for a coordinated program, the importance of the following facts must be noted:

Much can be done by utilizing the research of the last twelve years and by incorporating the resulting new approach into future design and development. Every one concerned with the present military program knows we do not have resources to waste on the altar of unnecessary attrition. But the argument of cost is two-edged—the expensive undertaking of fungus control would be truly offset by the tremendous savings possible.

Maintenance "Salesmen"

The Division Ordnance Battalion is now an integral part of the Army's combat formation and provides the "sales engineers" who must interest the assault forces in understanding and maintaining their equipment

Maj. Thomas J. McDonald

INDUSTRIAL equipment suppliers provide users of their equipment with technical service. In some lines, plant follow-up by sales engineers is as vital a part of an equipment sale as the contract itself.

Intricate machinery requires close service support. Users must be shown its secrets and made to understand its capabilities, limitations, and the penalties of abuse. Management must appreciate requirements for supply, maintenance, and repair, as well as the economic point for replacement instead of further repair.

With industrial equipment, sales engineering pays off in repeat sales. With ordnance equipment for the fighting troops, it pays off in more firepower, greater mobility, and reduced losses from enemy weapons. Playing a vital rôle in this sales-engineering effort is the Division Ordnance Battalion, an integral part of the Army's basic combat formation. It provides the Ordnance "sales engineers" with the assault forces.

THE armored division of 14,906 men has a three-company Ordnance battalion of 641 troops. The 17,509-man infantry division's Ordnance battalion contains 328 men. Airborne division organization is similar to that of infantry.

These three types of Ordnance units stand at the end of the pipeline, the last step in the laboratory-factory-depot system, representing Ordnance at the breech of the gun.

Some of the particular problems faced by the division Ordnance Officer include the following:

Major McDonald is Ordnance representative and instructor at the Command and General Staff College, Fort Leavenworth, Kans.

During training, new men must be introduced to ordnance equipment; new equipment must be introduced to old units—a sizable task performed in Korea with the new family of vehicles; and sometimes seasoned units must be reconciled to continued use of obsolescent equipment as dictated by exigencies of supply economy. This problem, faced during part of the Korean war, required greater emphasis than ever on the development of good unit maintenance procedures.

The old Army system, when a Springfield rifle was issued to a recruit under the watchful eye of the first sergeant to become his most cherished possession, is difficult to keep alive in this jet age when the rifle has so many complicated auxiliaries and rotation delivers personnel as casuals rather than as members of closely knit fighting units.

However, the division Ordnance Officer continues to drive home the importance of individual proprietorship and responsibility for all equipment—a never-ending campaign among the subordinate units of the division.

This is extremely difficult to implement in combat, and the efforts of the Army's present Assistant Chief of Staff for Personnel to overcome the manpower problem and introduce a system of unit replacement by battalion, and eventually by regiment, will go a long way toward improving maintenance standards.

Within the broad limits of established policy, the division Ordnance Officer determines what levels of repair and maintenance will be accomplished at each echelon, within the division's shop system, and works hard to develop a healthy competitive maintenance spirit among the units and their shops.

AMERICANS have great mechanical know-how, but it is not always as apparent in a front-line division where the soldier and sometimes his leader can be surprisingly oblivious to maintenance requirements. Rigors of weather and terrain exact their toll of human energy, and that drain is soon felt in deadlined vehicles, malfunctioning equipment, and fast wear-out rates.

Today's division commander is well aware of the problem, and the Ordnance Officer works with command support of a higher order than the sales engineer of an equipment supplier would expect from a manager of a customer firm.

Where life itself may hinge on a carbine stoppage or the continued operation of a tank engine, strong motivation is present, but swift changes in personnel and the fluidity of battle

are complicating factors, compounded sometimes by ignorance or negligence.

The infantryman judges artillery by its devastating effect on the enemy, but he also thinks in terms of short rounds, which may possibly be the result of inexperienced gunners who have abused their fuzes, tampered with firing mechanisms, or altered equipment in the field without authorization.

Beer cans over fuzes, which emit weird and wonderful whistles, worry the enemy—but they also worry Ordnance. Lanyards tied so that howitzers will discharge before the piece has returned to battery, can cause disaster. Prematures which wipe out gun crews or the inability to locate targets quickly are conditions which may stem from failures, abuses, or lack of knowledge in the field. Helping to whip such things is part of the Ordnance "sales-engineering" job.

THE Division Ordnance Battalions support fighting "cities" of 15,000 to 20,000 men, some 3,000 tanks and trucks, hundreds of artillery weapons, and other equipment. They work under climatic and weather conditions which run the gamut from difficult to practically impossible, in extremes of urgency and tactical pressure. They contend with personnel changes among their customers and staff which would discourage industrial efficiency experts.

Pentagon plans for activating new divisions in a full mobilization envisage selection of the division Ordnance Officer by the Department of the Army and activation of Division Ordnance Battalions early enough for them to introduce divisional units to their equipment through schools, briefings, and instructor visits.

The division Ordnance Officer plans his "sales engineering program," and with the approval of the commanding general helps to build up proper attitudes, procedures, and practices among the various units of the division, particularly in the various maintenance shops.

To assist him in this and related tasks the division Ordnance Officer commands the Division Ordnance Battalion—the only Ordnance unit within the field army which is not under the direct control of the Army Ordnance Officer. It is as much a part of the division as a rifle company or the division Engineer battalion. (It represents a moderate increase in the infantry and airborne Ordnance units from the company-size organization which existed prior to 1953.)

"Although it is only one side of a complicated job, 'sales engineering' at the division level is highly important. The officers and men representing Ordnance in this critical area constitute only approximately a quarter of the Ordnance strength in a typical field army, but their influence can be felt out of all proportion to their strength."

Except for technical channels to the corps and army Ordnance sections, the division Ordnance Officer has the same status as any other staff officer or commander in the division, but he can never lose sight of the bond which links him to the Ordnance organization behind the division rear boundary. He plays the rôle of sales-engineer for the corporation which has supplied the products, even though he is on the customer's pay roll.

He must endeavor to keep the rear echelon of Ordnance informed with respect to front-line conditions and interpret rear-area Ordnance problems of the moment to his commander.

His immediate staff includes an executive officer who maintains control records based on daily reports from divisional units, a system indicating over-all percentages deadlined by unit, backlog levels, and production dates on subordinate unit and ordnance shops, and repair and evacuation statistics.

This officer directs a heavy schedule of technical-assistance visits and staff inspections which constitute the bulk of the sales-engineering program. These visits are carried out by the division Ordnance Officer, staff officers, and key enlisted personnel. Criticisms are constructive and visits as informal as practicable.

HOWEVER, gross negligence or failure to attain desired standards inevitably lead to recommendations for command action. On the battalion staff, the division maintenance officer bears particular responsibility for implementing this program with respect to maintenance procedures.

The division Ordnance Supply Officer has a related task, which is equally important. He anticipates requirements for supplies and maintains stock levels —hence the battalion's vital mobility— at an optimum level.

By policing stock levels in subordinate units and encouraging unit supply officers to reduce unnecessary consumption he influences economy. By eliminating hoarding and ferreting out waste, exercising follow-up to preclude the abandonment of material, and helping to improve accounting and storage, he assists in improving the supply system.

He continually strives to make it as responsive as possible to the customers' requirements. He fosters lateral supply on critical parts by maintaining close liaison with supporting and adjacent units and with the various elements of the division. He fights a continuing battle to reduce the amount of equipment deadlined due to lack of spare parts.

Division supply officers in Korea accomplished wonders of supply, screening deadline reports from divisional units far into the nights and directing the interchange of parts between units. This helped greatly in reducing deadlines. The urge to overstock customers' shelves with parts is restrained in the interest of maximum mobility and reducing the strain on the pipeline.

THE next and perhaps most important of all the "sales engineering" assistants on the battalion staff is the Division Ammunition Officer, or DAO, who is responsible to the division Ordnance Officer that every unit of the division maintains proper levels of ammunition on hand, that the flow is continuous and efficient, and that technical aspects of ammunition use and safety are continually considered throughout the division.

In addition to orienting troops on new developments, inspecting dumps and positions to insure satisfactory maintenance and safety practices, the DAO has two enlisted explosives-ordnance specialists—"bomb-disposal" men who deal with the considerable problem of front-line dud removal, bomb disposal, and a variety of problems concerning ammunition, such as the removal of projectiles jammed in disabled artillery barrels or, as a field expedient, improvising illuminating

mortar ammunition out of rifle grenades.

The operating personnel of the Ordnance battalion consist of supply, maintenance, and ammunition specialists as well as overhead personnel such as cooks and drivers. These men range from highly qualified warrant officers with years of service, the backbone of some units, to recent arrivals, many of whom are trained at the Ordnance School.

THE division Ordnance battalions are fully mobile with shops operating in specially equipped trucks or under canvas. The battalions may operate on a consolidated basis, as for extensive rehabilitation programs during division reserve periods, or be broken up into companies or detached elements supporting individual combat commands or regiments, as in more fluid situations. Regardless of dispersion they usually function under the direct command of the division Ordnance Officer.

Under field conditions, hard standing and comfortable work space are virtually unknown. Illumination and adequately heated shelters are a luxury in fast-moving situations, and living conditions are not far removed from the foxhole level of the infantry. Indeed, the technical-assistance teams spend much of their time in infantry, tank, and artillery unit areas in the conduct of their "sales engineering" effort.

The battalion work and bivouac areas, dispersed over thousands of yards, present problems of construction and maintenance, as the unit frequently is dependent on its own resources for interior road construction and maintenance. There are few frills and much backbreaking work—tearing down, moving, and reëstablishing shop facilities for Ordnance service.

In addition to its field visits, the battalion makes third-echelon repairs for the entire division, exercising responsibility for wheeled and tracked vehicles, small arms, artillery, fire-control instruments, and other miscellaneous items of Ordnance equipment.

The workload is heavy, although the battalion can depend for assistance upon other Ordnance battalions under the field army's control. Other technical service equipment such as Signal Corps and Corps of Engineers, may receive emergency support from the Ordnance battalion. Such things as electrical generators and Engineer compressors sometimes appear in the Ordnance shops for urgent repairs.

In Korea the United States divisions were augmented with United Nations organizations ranging in size from battalions to combat teams. These units mainly used our equipment and represented an additional drain on Ordnance resources, inasmuch as personnel were sometimes unskilled in the rudiments of basic maintenance or unacquainted with the details of United States maintenance procedures.

Full use is made of indigenous labor, military and civilian, where this is possible, and in Korea the troops augmented their strength with native personnel who developed valuable skills.

In addition to the field army Ordnance battalions which provide support to the division units, ballistics, technical-intelligence, and explosives-ordnance teams are available from the same source. These troops work closely with the divisional units and render valuable assistance.

As part of its "sales engineering" service, division Ordnance operates rehabilitation shops for countless parts and subassemblies which can be returned to use in the field. It operates an effective "no-paper" over-the-counter, exchange of selected parts, rehabilitated as well as new, with units of the division.

The battalion preserves and ships badly damaged and salvaged items to the rear, collecting and processing captured ordnance items. It operates tank-recovery vehicles under enemy fire and trains itself to fight in self-defense. It evacuates worn-out vehicles and either picks up or arranges for the delivery from army of replacement items.

ALTHOUGH it is only one side of a complicated job, "sales engineering" at the division level is highly important. The officers and men representing Ordnance in this critical area constitute only approximately a quarter of the Ordnance strength in a typical field army, but their influence can be felt out of all proportion to their strength.

Ordnance product effectiveness depends heavily on the personnel of these units, from the division Ordnance Officer to the last mechanic on a technical-assistance team. Ordnance product effectiveness in the fighting divisions is far more than storage and issue, fix or replace—it requires skilled, enthusiastic, technical specialists who want to be there. It requires strength, stamina, imagination, and unusually high reserves of patience. It calls upon resources of personality and salesmanship, based on belief in Ordnance matériel and the proud traditions of the Ordnance Corps.

Product effectiveness may determine the outcome of our battles. The division Ordnance battalions—paratroop, armored, or infantry—are working hard in this belief and the sure knowledge that the battle is still the payoff.

Artillery contact teams from Ordnance units gave almost daily maintenance assistance to batteries during heavy Korean fighting (Army photo).

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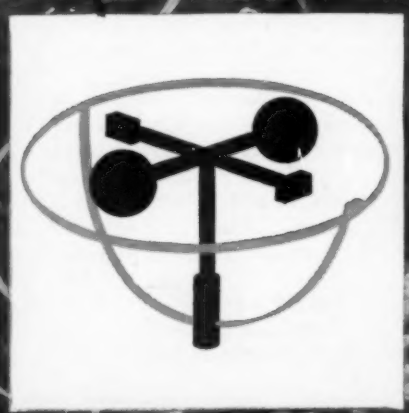

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ORDNANCE

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AMERICAN ORDNANCE ASSOCIATION

Founded 1919

A patriotic, educational, scientific, nonpolitical, and nonprofit-making organization of American citizens dedicated to scientific and industrial preparedness for the common defense

ORDNANCE is the generic term embracing:

All weapons, armament, and appurtenances for their operation and maintenance, whether land-based, on or under the sea or airborne, including—

All ammunition and its chemical, metallurgical, and atomic components.

All rockets, bombs, guided missiles, torpedoes, depth charges, and mines.

All combat vehicles, tanks, tank destroyers, and weapon carriers.

All vehicles for automotive transport of personnel and matériel on land.

All optical, aërial, mechanical, electrical, and electronic systems for locating and tracking targets on land, at sea, and in the air.

- The need for a civilian association of private citizens to coöperate with the ordnance organizations of our Armed Forces arises from the fact that, in the United States, in accordance with traditional national policy, there is little or no private industry for the production of ordnance in time of peace. Yet in time of emergency, as our experience in two world wars so tragically proved, ordnance of superior quality and in great quantities must be available in a very minimum of time for the use of our armed forces in order to avoid incurring unnecessary expenditures of hundreds of millions of dollars and, infinitely more important, the sacrifice of hundreds of thousands of American lives.

- Trained scientists and engineers in the laboratories and industrial establishments of our country, alert executives and key men of our factories and plants, students at our technical colleges, and artisans of our vast economy—all are united through membership in the American Ordnance Association in the firm determination to achieve peace through strength by providing superior ordnance for our Armed Forces.

- To keep alive a knowledge of ordnance design and production; to assist in the solution of the ramified technical, scientific, and economic problems incident to ordnance preparedness; to weld into an active, alert, and skilled group all eligible citizens for the advancement of scientific and industrial preparedness, and thus to contribute to the strength of our national security and the maintenance of peace—these are the goals of the American Ordnance Association, and to these ends its constitution and by-laws are directed. An organization chart of the Association is on pages 20 and 21.

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First Vice-President: (*to be elected*)
Second Vice-President: (*to be elected*)
Secretary-Treasurer: B. E. Jones, The Citadel, Charleston, S. C.
Directors: H. H. Moorer, Charleston, S. C.
F. H. Radspinner, Darlington, S. C.

Cleveland Post, October 25, 1940

President: Albert J. Weatherhead, Jr., Weatherhead Company, Cleveland, Ohio.
Vice-Presidents: J. E. Trainer, Firestone Tire & Rubber Company, Akron, Ohio.
William H. Forster, Jr., Hays Manufacturing Company, Erie, Pa.
Secretary-Treasurer: J. C. McHannan, Central National Bank of Cleveland, Cleveland, Ohio.
Executive Secretary: Seward Covert, Seward Covert & Associates, Cleveland, Ohio.
Directors: Robert F. Black, White Motor Company, Cleveland, Ohio.
Harold R. Boyer, Cleveland Cadillac Tank Plant, Cleveland, Ohio.
George C. Brainard, Addressograph-Multigraph Company, Euclid, Ohio.
Ward M. Canaday, Overland Corporation, Toledo, Ohio.
Fred H. Chapin, National Acme Company, Cleveland, Ohio.
Frederick C. Crawford, Thompson Products Company, Euclid, Ohio.
Clyde T. Foster, Standard Oil Company, Cleveland, Ohio.
John A. Greene, Ohio Bell Telephone Company, Cleveland, Ohio.
Ben F. Hopkins, Cleveland Graphite Bronze Company, Cleveland, Ohio.
H. P. Ladds, National Screw & Manufacturing Company, Cleveland, Ohio.
W. G. Laffer, Cleveland Graphite Bronze Company, Cleveland, Ohio.
Albert Miller, Central Ohio Paper Company, Columbus, Ohio.
Walter F. Munford, American Steel & Wire Company, Cleveland, Ohio.
William I. Ong, American Steel & Wire Company, Cleveland, Ohio.
T. F. Patton, Republic Steel Corporation, Cleveland, Ohio.
William S. Richardson, B. F. Goodrich Company, Akron, Ohio.
H. A. Roemer, Jr., Sharon Steel Corporation, Sharon, Pa.
Hermon Safford, Ohio Rubber Company, Willoughby, Ohio.
A. W. Steudel, Sherwin-Williams Company, Cleveland, Ohio.
Charles J. Stilwell, Warner & Swasey Company, Cleveland, Ohio.
W. Robert Timken, Timken Roller Bearing Company, Canton, Ohio.
Edwin J. Thomas, Goodyear Tire & Rubber Company, Akron, Ohio.
William A. Weaver, Griswold-Eshleman Company, Cleveland, Ohio.
Charles M. White, Republic Steel Corporation, Cleveland, Ohio.
Dr. Clyde W. Williams, Battelle Memorial Institute, Columbus, Ohio.

Columbia River Post, June 14, 1950

President: Edward A. Haas, Ballou & Wright, Portland, Oreg.
First Vice-President: John Bergman, Vancouver, Wash.
Second Vice-President: H. R. Matheson, Portland, Oreg.
Treasurer: Delmar C. Wise, Kirk & Company, Portland, Oreg.
Secretary: Theodore Emerson, Bonneville Power Administration, Portland, Oreg.
Directors: William P. Allyn, U. S. National Bank, Portland, Oreg.
T. L. Bryant, Iron Fireman Manufacturing Company, Portland, Oreg.
Paul Fowler, Fowler Manufacturing Company, Portland, Oreg.
J. A. Gay, Lomac Motors, Portland, Oreg.
G. E. Healy, Portland, Oreg.
H. D. Kness, Kness & Company, Portland, Oreg.
H. T. Lowry, Iron Fireman Manufacturing Company, Portland, Oreg.
C. G. Tupling, Bearing Sales & Service, Portland, Oreg.

Empire Post, April 29, 1938

President: Ray C. Malvin, U. S. Hoffman Machinery Corporation, Auburn, N. Y.
First Vice-President: Francis R. Gorman, Gorman & Halpern, Utica, N. Y.
Second Vice-President: Michael J. Lawlor, Ansco Corporation, Binghamton, N. Y.
Treasurer: Raymond M. Biehler, Rochester Institute of Technology, Rochester, N. Y.
Secretary: Edward G. Miller, Rochester Ordnance District, Rochester, N. Y.
Assistant Secretary: Ethel E. Henschel, Rochester Ordnance District, Rochester, N. Y.
Directors: Alexander M. Beebee, Rochester Gas & Electric Corporation, Rochester, N. Y.
Robert E. Dillon, Lake Erie Engineering Corporation, Buffalo, N. Y.
Mark Ellingson, Rochester Institute of Technology, Rochester, N. Y.
Philip P. Glassey, Easy Washing Machine Company, Syracuse, N. Y.
James E. Gleason, Gleason Works, Rochester, N. Y.
Francis R. Gorman, Gorman & Halpern, Utica, N. Y.

Edward A. Halblieb, Victor Insulators, Inc., Rochester, N. Y.
Carl S. Hallauer, Bausch & Lomb Optical Company, Rochester, N. Y.
Fred F. Hickey, Savage Arms Corporation, Utica, N. Y.
Thomas L. Lee, Rochester, N. Y.
Reginald A. Lenna, Blackstone Corporation, Jamestown, N. Y.
Ray C. Malvin, U. S. Hoffman Machinery Corporation, Auburn, N. Y.
Charles F. Mosher, Henderson-Mosher, Inc., Rochester, N. Y.
Richard H. Pass, Onondaga Pottery Company, Syracuse, N. Y.
Ralph F. Peo, Frontier Industries, Inc., Buffalo, N. Y.
H. B. Sheets, Marine Trust Company, Buffalo, N. Y.
Lyman K. Stuart, C. H. Stuart & Company, Newark, N. J.
Douglas B. Whitney, Harrison Radiator Division, GMC, Lockport, N. Y.

Frontier Chapter, Empire Post

Chairman: H. B. Sheets, Marine Trust Company, Buffalo, N. Y.
Membership Committee: Ray C. Neal, R. C. Neal Company, Buffalo, N. Y.
Steering Committee Chairman: Keith Williams, Pratt & Letchworth Company, Buffalo, N. Y.
Treasurer: Walter Schmidt, Niagara Mohawk Power & Light Company, Niagara Falls, N. Y.

Jamestown Chapter, Empire Post

Chairman: C. Earl Norquist, Norquist Products, Inc., Jamestown, N. Y.

Mohawk Valley Chapter, Empire Post

Chairman: Francis R. Gorman, Gorman & Halpern, Utica, N. Y.
Vice-Chairman: Thomas Bright, Revere Copper & Brass Company, Rome, N. Y.

Rochester Chapter, Empire Post

Chairman: Ray M. Biehler, 1260 Sibley Tower Building, Rochester, N. Y.
Vice-Chairman: Orrin J. Mitchell, Union Steel Chest Company, LeRoy, N. Y.
Program Chairman: Earl T. Gruendike, General Railway Signal Company, Rochester, N. Y.

Southern Tier Chapter, Empire Post

Chairman: Claude Wright, Webster Industries, Webster, N. Y.
Secretary: F. N. Tracy, Ward LaFrance Truck Corporation, Elmira, N. Y.

Syracuse-Central New York Chapter, Empire Post

Chairman: Robert I. Hicks, Lamson Corporation, Syracuse, N. Y.
First Vice-Chairman and Meeting Chairman: Paul L. Christensen, Onondaga Pottery Company, Syracuse, N. Y.
Second Vice-Chairman and Membership Chairman: Richard W. Noyes, Oneida, Ltd., Oneida, N. Y.
Vice-Chairmen: George R. Auld, Carrier Corporation, Syracuse, N. Y.
Fred N. Claypole, General Motors Corporation, Syracuse, N. Y.
V. M. Lucas, General Electric Company, Syracuse, N. Y.
Charles D. Osborne, *Auburn Citizen-Advertiser,* Auburn, N. Y.
Clifford Palmer, Cleveland Container Company, Ogdensburg, N. Y.
Jay R. Petree, Crouse-Hinds Company, Syracuse, N. Y.
Mark Russell, Pass & Seymour, Inc., Syracuse, N. Y.
Edwin R. Tharp, Easy Washing Machine Corporation, Syracuse, N. Y.
Gustav F. Watters, Niagara Mohawk Power Corporation, Syracuse, N. Y.
Secretary: E. Gwyn Thomas, Manufacturers Association of Syracuse, Syracuse, N. Y.

Tri-Cities Chapter, Empire Post

President: Michael J. Lawlor, Ansco Corporation, Binghamton, N. Y.
Vice-President: Charles F. McElwain, International Business Machines Corporation, New York, N. Y.
Secretary-Treasurer: John H. Bouman, Ansco Corporation, Binghamton, N. Y.

Florida Post, June 12, 1951

President: Paul S. Bechtel, Eglin Air Force Base, Fla.
First Vice-President: Enloe R. Grey, Eglin Air Force Base, Fla.
Second Vice-President: Francis J. Hale, Eglin Air Force Base, Fla.
Treasurer: John J. Murphy, Fort Walton, Fla.
Secretary: Kenneth E. Brown, Eglin Air Force Base, Fla.
Directors: George E. Bowden, Eglin Air Force Base, Fla.
Edward W. Clarno, Eglin Air Force Base, Fla.
George M. Corrigan, Metal Products Company, Miami, Fla.
Gilbert Foster, Eglin Air Force Base, Fla.
Alex D. Ginzburg, Eglin Air Force Base, Fla.
James W. Heyroth, Eglin Air Force Base, Fla.
Fred A. McMahon, Miami Beach, Fla.
Thomas G. Monroe, Eglin Air Force Base, Fla.
Joseph D. Murray, Fort Lauderdale, Fla.
Ward E. Protsman, Eglin Air Force Base, Fla.
Robert L. Reeder, Eglin Air Force Base, Fla.
Louis Schaffer, Eglin Air Force Base, Fla.

Hartford-Springfield Post, November 18, 1941

President: S. C. Hope, Esso Standard Oil Company, New York, N. Y.
Vice-Presidents: J. H. Chaplin, Veeder-Root, Inc., Hartford, Conn.
C. H. Granger, Waterbury, Conn.
Secretary-Treasurer: J. A. MacDonnell, Gilbert & Barker Manufacturing Company, West Springfield, Mass.
Directors: F. H. Payne, Springfield, Mass., *chairman;* the officers and
G. H. Anthony, Colt's Manufacturing Co., Hartford, Conn.
J. S. Begley, Holyoke, Mass.
William J. Crowe, Longmeadow, Mass.
C. K. Davis, Remington Arms Company, Bridgeport, Conn.
G. H. Drewry, Niles-Bement-Pond Company, West Hartford, Conn.
W. M. Goss, Scovill Manufacturing Company, Waterbury, Conn.
James L. Guion, Springfield, Mass.
C. R. Hellstrom, Smith & Wesson, Inc., Springfield, Mass.
D. P. Hess, American Bosch Corporation, Springfield, Mass.
George E. Hughes, Springfield Ordnance District, Springfield, Mass.
D. G. Ludlam, Springfield Armory, Springfield, Mass.
D. G. Millar, Greenfield Tap and Die Corporation, Greenfield, Mass.
H. H. Pease, New Britain Machine Company, New Britain, Conn.
R. E. Pritchard, Stanley Works, New Britain, Conn.
E. S. Pugsley, New Haven, Conn.
James Y. Scott, Van Norman Company, Springfield, Mass.
H. W. Steinkraus, Bridgeport Brass Company, Bridgeport, Conn.
James R. Weaver, Westinghouse Electric Corporation, Springfield, Mass.

Lone Star Post, June 12, 1945

President: Warren W. Wells, Henningson Inc., Fort Worth, Tex.
Vice-President: R. H. Norris, Dearborn Stove Company, Dallas, Tex.
Secretary-Treasurer: W. M. Harrison, Crown Machine & Tool Company, Fort Worth, Tex.

Directors: C. A. Fischer, Harbison-Fischer Company, Fort Worth, Tex.
R. F. Flanagan, R. G. LeTourneau, Inc., Longview, Tex.
C. V. Fletcher, Dallas, Tex.
F. L. LeBus, LeBus Tool Company, Longview, Tex.
F. B. McKimball, Southwest Gauge Company, Dallas, Tex.
M. J. Neeley, Hobbs Manufacturing Company, Fort Worth, Tex.
John Wilson, Wilson Manufacturing Company, Wichita Falls, Tex.

Los Angeles Post, May 27, 1936

President: R. C. Geffs, Clary Multiplier Corporation, San Gabriel, Calif.
Vice-President: E. C. Hummel, Utility Electric Steel Foundry, Los Angeles, Calif.
Treasurer: Samuel K. Rindge, Citizens National Trust & Savings Bank, Los Angeles, Calif.
Secretary: R. W. Reniers, Standard Coil Products Company, P. O. Box 2262, Terminal Annex, Los Angeles 54, Calif.
Directors: T. T. Arden, Grayson Controls, Lynwood, Calif.
Omar N. Bradley, Aerojet-General Corporation, Azusa, Calif.
F. W. Conant, Douglas Aircraft Company, Santa Monica, Calif.
Gordon B. Crary, Jr., E. F. Hutton & Company, Los Angeles, Calif.
Louis G. Dunn, California Institute of Technology, Pasadena, Calif.
Robert C. Geffs, Clary Multiplier Corporation, San Gabriel, Calif.
H. L. Hoffman, Hoffman Laboratories, Inc., Los Angeles, Calif.
E. C. Hummell, Utility Steel Foundry, Los Angeles, Calif.
E. M. Jorgenson, Jorgenson Steel Co., Los Angeles, Calif.
Patrick Lizza, Bermite Powder Company, Saugus, Calif.
James P. McCafferty, Los Angeles, Calif.
William B. McGee, Hughes Aircraft Company, Los Angeles, Calif.
K. T. Norris, Norris-Thermador Corp., Los Angeles, Calif.
Morris Pendleton, Plomb Tool Company, Los Angeles, Calif.
John B. Rauen, U. S. Spring & Bumper Company, Los Angeles, Calif.
R. W. Reniers, Standard Coil Products, Los Angeles, Calif.
S. K. Rindge, Citizens National Bank, Los Angeles, Calif.
C. B. Tibbetts, Los Angeles Steel Casting Company, Los Angeles, Calif.
William A. Wilson, Web Wilson Oil Tools Company, Los Angeles, Calif.
W. E. Zander, Rheem Manufacturing Company, South Gate, Calif.

Louisiana Post, May 24, 1950

Acting President: R. L. Telford, Silas Mason Company, Shreveport, La.
Acting Secretary-Treasurer: Ray Samuel, Higgins, Inc., New Orleans, La.
Directors: Ernest A. Merklein, Merklein and Company, Shreveport, La.
W. C. Nabors, W. C. Nabors Company, Mansfield, La.

New Orleans Chapter, Louisiana Post

President: Willard L. Love, Rheem Manufacturing Company, New Orleans, La.
Vice-President: R. A. Murphy, Jr., Higgins, Inc., New Orleans, La.
Secretary-Treasurer: T. D. Hoskins, Louisiana Power & Light Company, New Orleans, La.

Massachusetts Institute of Technology Post, January 20, 1922

President: Stanley A. Hoff, Cambridge, Mass.
Vice-President: Ernest P. Abrahamson, II, Cambridge, Mass.
Executive Committee: Julio B. Arroyo, Cambridge, Mass.
Secretary-Treasurer: Robert H. Tucker, 362 Memorial Drive, Cambridge, Mass.
Faculty Adviser: Maj. William Mattis, Ordnance Corps, R.O.T.C. Ordnance Detachment, Massachusetts Institute of Technology, Cambridge, Mass.

Michigan Post, December 12, 1942

President: Charles L. Jacobson, Chrysler Motor Parts Corporation, Detroit, Mich.
Vice-Presidents: Britton L. Gordon, Blackmer Pump Company, Grand Rapids, Mich.
James K. Fulks, Ex-Cell-O Corporation, Detroit, Mich.
Secretary-Treasurer: Charles W. Brownell, National Bank of Detroit, Detroit, Mich.
Directors: Thomas Couper, L. A. Young Spring & Wire Corporation, Detroit, Mich.
William M. Day, Michigan Bell Telephone Company, Detroit, Mich.
Irving A. Duffy, Ford Motor Company, Detroit, Mich.
J. Frank Forster, Vickers, Inc., Detroit, Mich.
James K. Fulks, Ex-Cell-O Corporation, Detroit, Mich.
Britton L. Gordon, Blackmer Pump Company, Grand Rapids, Mich.
John F. Gordon, General Motors Corporation, Detroit, Mich.
Charles L. Jacobson, Chrysler Motor Parts Corporation, Detroit, Mich.
V. H. Kendall, Universal Products Company, Dearborn, Mich.
C. Jack Reese, Continental Aviation & Engineering Corporation, Muskegon, Mich.
Joseph S. Sherer, Jr., Reo Motors, Inc., Lansing, Mich.
J. Thomas Smith, Detroit Harvester Company, Detroit, Mich.
F. Russell Valpey, Standard Products Company, Detroit, Mich.
Herbert R. White, Eclipse Counterbore Company, Ferndale, Mich.
A. M. Wibel, Nash-Kelvinator Corporation, Detroit, Mich.

Lansing Chapter, Michigan Post

President: Lester F. Carlson, Oldsmobile Division, GMC, Lansing, Mich.
Vice-President: Glen Whisler, Reo Motors, Inc., Lansing, Mich.
Secretary: Eldon Robbins, John Bean Division, Food Machinery & Chemical Corporation, Lansing 4, Mich.
Directors: Barney C. Cox, Melling Forging Company, Lansing, Mich.
Fredrik Marin, Bank of Lansing, Lansing, Mich.
Clarence A. Trump, Fisher Body Division, GMC, Lansing, Mich.

Western Michigan Chapter, Michigan Post

President: Elisha Gray, II, Whirlpool Corporation, St. Joseph, Mich.
Vice-President: S. K. Harrington, Kalamazoo Manufacturing Company, Kalamazoo, Mich.
Secretary: Britton L. Gordon, Blackmer Pump Company, Grand Rapids, Mich.
Directors: Gordon B. Bonfield, American Box Board Company, Filer City, Mich.
Britton L. Gordon, Blackmer Pump Company, Grand Rapids, Mich.
Elisha Gray, II, Whirlpool Corporation, St. Joseph, Mich.
S. K. Harrington, Kalamazoo Manufacturing Company, Kalamazoo, Mich.
Don R. Mitchell, Mitchell-Bentley Corporation, Ionia, Mich.
Roger Waindle, Wai-Met Engineering Company, Muskegon, Mich.

Mid-Continent Post, December 12, 1944

President: M. H. Johnson, Independent Plow, Inc., Neodesha, Kans.
Vice-President: R. R. King, American Body & Trailer Company, Oklahoma City, Okla.
Consulting Engineer: W. H. Stueve, Oklahoma City, Okla.
Secretary-Treasurer: C. R. Horton, Horton Engineering Company, 8211 E. Seventh Street, Tulsa, Okla.
Directors: Frank Hinderliter, Tulsa, Okla.
George Nicholson, Tulsa, Okla.
Walter O'Bannon, Jr., Tulsa, Okla.
Ed Warmack, Warmack Stove Company, Fort Smith, Ark.

Midwest Post, May 16, 1945

President: Harry Darby, Darby Corporation, Kansas City, Kans.
Vice-President: C. M. Standiford, Crawford Manufacturing Company, Kansas City, Kans.
Secretary-Treasurer: Fred B. Nichols, Mid-Continent Paint Manufacturing Company, 1921 Central Street, Kansas City 8, Mo.
Directors: Leroy M. Alexander, Sheffield Steel Corporation, Kansas City, Mo.
Paul Froeschl, Wilde Drop Forge & Tool Company, Kansas City, Mo.
Elmer Pierson, Vendo Company, Kansas City, Mo.
Philip Rahm, Kansas City, Mo.
Kenneth Spencer, Spencer Chemical Company, Kansas City, Mo.

Milwaukee Post, September 26, 1928

President: Frederick D. Hansen, Evans-Hansen, Milwaukee, Wis.
Vice-Presidents: C. Knight Charlton, Bucyrus-Erie Company, South Milwaukee, Wis.
W. C. Messinger, Chain Belt Company, Milwaukee, Wis.
Secretary-Treasurer: Jacobus Kruyne, Home Savings Bank, 2200 North Third Street, Milwaukee, Wis.
Directors: P. H. Batten, Twin-Disk Clutch Company, Racine, Wis.
C. Knight Charlton, Bucyrus-Erie Company, South Milwaukee, Wis.
Leon R. Clausen, J. I. Case Company, Racine, Wis.
W. W. Coleman, Bucyrus-Erie Company, South Milwaukee, Wis.
J. E. De Long, Waukesha Motors Corporation, Waukesha, Wis.
Harold S. Falk, Falk Corporation, Milwaukee, Wis.
Frederick D. Hansen, Evans-Hansen, Milwaukee, Wis.
W. C. Heath, A. O. Smith Corporation, Milwaukee, Wis.
H. Stanley Johnson, Jr., Gisholt Machine Company, Madison, Wis.
Herbert V. Kohler, Kohler Company, Kohler, Wis.
J. Clifford Merwin, Chain Belt Company, Milwaukee, Wis.
W. C. Messinger, Chain Belt Company, Milwaukee, Wis.
W. G. Prasse, Oilgear Company, Milwaukee, Wis.
William A. Roberts, Allis-Chalmers Manufacturing Company, West Allis, Wis.
Robert A. Uihlein, Jos. Schlitz Brewing Company, Milwaukee, Wis.
Pierpont J. E. Wood, Jeffres, Mouat, Oestreich, Wood & Cunningham, Janesville, Wis.

Nebraska Post, June 22, 1944

President: Dana C. Bradford, Bradford-Kennedy Company, Omaha, Nebr.
Vice-President: Robert Bernstein, Independent Metals Company, Omaha, Nebr.
Secretary-Treasurer: Fred G. Arkoosh, Wilkinson Manufacturing Company, P.O. Box 127, Florence Station 12, Omaha, Nebr.
Directors: Robert Ammon, Cushman Motor Works, Inc., Lincoln, Nebr.
Frederick Bucholz, Omaha Steel Works, Omaha, Nebr.
Clyde B. Dempster, Dempster Mill Manufacturing Company, Beatrice, Nebr.
Burr Hughes, Hughes Brothers, Seward, Nebr.
John McCague, Jubilee Manufacturing Company, Omaha, Nebr.
Karl Vogel, State Senator, Omaha, Nebr.
Keith Waugh, Meade Ordnance Plant, Wahoo, Nebr.

New York Post, June 15, 1921

President: R. L. Maxwell, American Machine & Foundry Company, New York, N. Y.
Vice-Presidents: J. L. Auer, R. Hoe & Company, New York, N. Y.
H. T. Luria, Luria Steel & Trading Corporation, New York, N. Y.
J. G. Phillips, International Business Machines Corporation, New York, N. Y.
Secretary-Treasurer: J. W. Graham, New York Ordnance District, 180 Varick Street, New York 14, N. Y.
Directors: George W. Allison, Kings Point, N. Y.
Nelson Anderson, Eastern Tool & Manufacturing Company, Belleville, N. J.
Paul T. Cullen, Sperry Gyroscope Company, Great Neck, N. Y.
William E. Eisner, American Visuals Corporation, New York, N. Y.
Arnold Erlanger, U. S. Hoffman Machinery Corporation, New York, N. Y.
W. R. Janney, National Can Corporation, New York, N. Y.
D. B. MacMaster, L. R. Beavis & Company, Ridgewood, N. Y.
Chester Mueller, Newark, N. J.
Henry N. Sachs, Frank Crystal & Company, New York, N. Y.
L. W. Stearns, Metropolitan Life Insurance Company, New York, N. Y.
A. E. Van Cleve, Crucible Steel of America, New York, N .Y.
Gordon B. Welch, Mergenthaler Linotype Company, Brooklyn, N. Y.

Northwest Post, March 15, 1945

President: W. C. MacFarlane, Sr., Minneapolis-Moline Company, Minneapolis, Minn.
Vice-Presidents: Harold W. Sweatt, Minneapolis-Honeywell Regulator Company, Minneapolis, Minn.
Charles L. Horn, Federal Cartridge Corporation, Minneapolis, Minn.
Secretary-Treasurer: Roland F. Wilson, 436 Palace Building Minneapolis 1, Minn.
Directors: The officers and Albert P. Baston, Baston Motor Company, St. Cloud, Minn.
Fred Blumers, General Mills, Inc., Minneapolis, Minn.
P. G. Bourne, Seeger Refrigerator Company, St. Paul, Minn.
Charles E. Buckbee, Buckbee Mears Company, St. Paul, Minn.
Harry A. Bullis, General Mills, Inc., Minneapolis, Minn.
Walter F. Kasper, Fairmont Railway Motors, Inc., Fairmont, Minn.
Warren C. MacFarlane, Jr., Minneapolis-Moline Company, Minneapolis, Minn.
Luther S. Oakes, Winston Brothers Company, Minneapolis, Minn.
David W. Onan, D. W. Onan & Sons, Inc., Minneapolis, Minn.
George H. Rozum, Rozum Brothers Motors Company, Watertown, S. Dak.
Walter G. Seeger, Seeger Refrigerator Company, St. Paul, Minn.
Donald A. Smith, Smith, Inc., Fargo, N. Dak.
Alton V. Stallard, San Francisco, Calif.
Frank B. Winston, Winston Brothers Company, Minneapolis, Minn.
Brison Wood, Minneapolis-Honeywell Regulator Company, Minneapolis, Minn.

Philadephia Post, December 9, 1926

President: William H. Worrilow, Sr., Lebanon Steel Foundry, Lebanon, Pa.
Vice-Presidents: Henry W. Gadsden, Sharp & Dohme Division, Merck & Company, Philadelphia, Pa.
Joseph H. Gillies, Philco Corporation, Philadelphia, Pa.
Howard S. Lewis, Parish Pressed Steel Company, Reading, Pa.
Walter C. Pew, Sun Oil Company, Philadelphia, Pa.
Secretary-Treasurer: Robert T. Gebler, Stewart Jordan Company, Lincoln Liberty Building, Philadelphia, Pa.
Directors: Robert H. Andrews, Philco Corporation, Philadelphia, Pa.
Edward G. Budd, Jr., Budd Company, Philadelphia, Pa.
William P. Drake, Pennsylvania Salt Manufacturing Company, Philadelphia, Pa.
H. Paul Gant, Glen Moore, Pa.
Albert W. Gilmer—Barnes, Dechert, Price, Myers & Rhoads, Philadelphia, Pa.
C. Jared Ingersoll, Muskogee Company, Philadelphia, Pa.
Ernest J. Langham, Sun Oil Company, Philadelphia, Pa.
Stewart Lauer, York Corporation, York, Pa.
Henry N. Marsh, Hercules Powder Company, Wilmington, Del.
William J. Meinel, Heintz Manufacturing Company, Philadelphia, Pa.
Richard T. Nalle, Midvale Company, Philadelphia, Pa.
Lewis M. Parsons, United States Steel Corporation, Philadelphia, Pa.
Howard C. Petersen, Fidelity-Philadelphia Trust Company, Philadelphia, Pa.
Martin Sandler, Daytona Beach, Fla.
Arthur J. Seiler, Gates Engineering Company, Wilmington, Del.
J. T. Simpson, Harrisburg Steel Corporation, Harrisburg, Pa.
Arthur Sinkler, Hamilton Watch Company, Lancaster, Pa.
Marvin W. Smith, Baldwin-Lima-Hamilton Corporation, Philadelphia, Pa.
George W. Struble, Bethlehem Steel Company, Bethlehem, Pa.
Everett B. Webster, Crown Cork & Seal Company, Philadelphia, Pa.

Pittsburgh Post, February 24, 1927

President: Alexander E. Walker, National Supply Company, Pittsburgh, Pa.
Vice-Presidents: Thomas E. Millsop, Weirton Steel Company, Weirton, W. Va.
Clifford F. Hood, United States Steel Corporation, Pittsburgh, Pa.
Treasurer: Thomas H. Eddy, George A. Kelly Company, Pittsburgh, Pa.
Secretary: William S. Rial, Jr., Morrison Rubber Company, 1324 Highland Building, Pittsburgh 6, Pa.
Directors: The officers and John A. Appleton, Pennsylvania Railroad Company, Pittsburgh, Pa.
Frank R. Denton, Mellon National Bank & Trust Company, Pittsburgh, Pa.
Robert C. Downie, Peoples First National Bank & Trust Company, Pittsburgh, Pa.
William K. Fitch, Dravo Corporation, Pittsburgh, Pa.
Kirkland C. Gardner, United Engineering & Foundry Company, Pittsburgh, Pa.
Harry B. Higgins, Pittsburgh Plate Glass Company, Pittsburgh, Pa.
Lorenz Iversen, Mesta Machine Company, West Homestead, Pa.
George H. Love, Pittsburgh-Consolidation Coal Company, Pittsburgh, Pa.
Ben Moreell, Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Gwilym A. Price, Westinghouse Electric Manufacturing Corporation, Pittsburgh, Pa.
Willard F. Rockwell, Jr., Rockwell Manufacturing Company, Philadelphia, Pa.
Brehon B. Somervell, Koppers Company, Pittsburgh, Pa.
Sidney A. Swensrud, Gulf Oil Corporation, Pittsburgh, Pa.
Irving W. Wilson, Aluminum Company of America, Pittsburgh, Pa.

Puget Sound Post, January 25, 1944

President: C. Walter Huffine, Massachusetts Mutual Life Insurance Company, Seattle, Wash.
Vice-President: Alex Thomson, Pacific Car and Foundry Company, Renton, Wash.
Secretary-Treasurer: Fairman B. Lee, Fairman B. Lee Company, Seattle, Wash.
Directors: Murray Aitken, Kenworth Motor Truck Corporation, Seattle, Wash.
Joseph A. Denn, Pacific Powder Company, Tacoma, Wash.
Watt Fallis, Kenworth Motor Truck Corporation, Seattle, Wash.
Paul Forsyth, Western Gear Works, Seattle, Wash.
H. P. Lawrence, Northwest Lead Company, Seattle, Wash.
George C. Martin, Boeing Airplane Company, Seattle, Wash.
Robert Nelson, Standard Service Tire Company, Seattle, Wash.
Ferdinand Schmitz, Berger Engineering Company, Spokane, Wash.
Alex Thomson, Pacific Car and Foundry Company, Renton, Wash.
Walter Toly, Columbia Electric Company, Spokane, Wash.
M. J. Williams, Seattle Office, San Francisco Ordnance District, Seattle, Wash.

Quad Cities-Iowa Post, May 28, 1945

President: P. S. Mumford, American Machine & Metals, Inc., East Moline, Ill.
Vice-President: C. E. Murray, Englehart Manufacturing Company, Davenport, Iowa.
Secretary-Treasurer: Donald L. Meyers, Rock Island Arsenal, Rock Island, Ill.
Directors: A. A. Collins, Collins Radio Company, Cedar Rapids, Iowa.
A. C. Danekind, The Maytag Company, Newton, Iowa.
L. M. Gildea, International Harvester Company, Rock Island, Ill.
G. H. Mathes, Iowa Ordnance Plant, Burlington, Iowa.
A. D. Matheson, French & Hecht Division, Kelsey-Hayes Wheel Company, Davenport, Iowa.
L. A. Murphy, Deere & Company, Moline, Ill.
E. W. Ross, Minneapolis-Moline Company, Moline, Ill.
M. M. Schmidt, Deere Manufacturing Company, Des Moines, Iowa.
G. A. Uhlmeyer, Iowa-Illinois Gas & Electric Company, Rock Island, Ill.
C. A. Waldman, Deere & Company, Moline, Ill.
G. L. Weissenburger, Keokuk Electro-Metals Company, Keokuk, Iowa.
C. D. Wiman, Deere & Company, Moline, Ill.

Rio Grande Post, November 6, 1952

President: Henry E. Minton, El Paso, Tex.
Vice-President: M. S. Darbyshire, Darbyshire Steel Company, El Paso, Tex.
Secretary-Treasurer: C. A. Lindeman, Darbyshire Steel Company, El Paso, Tex.
(*Other officers and directors to be elected.*)

Rocky Mountain Post, June 10, 1942

President: James D. Maitland, Cobusco Steel Products, Denver, Colo.
Vice-President: James Colasanti, Metal Treating & Research Company, Denver, Colo.
Secretary-Treasurer: Gerould A. Sabin, Colorado Fuel & Iron

Corporation, Room 806, Continental Oil Building, Denver, Colo.
Directors: C. C. Drake, Griffin Wheel Company, Denver, Colo.
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St. Louis Post, January 18, 1927

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San Francisco Post, October 17, 1923

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Texas Post, October 30, 1942

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Washington Post, November 18, 1925

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Yankee Post, June 30, 1925

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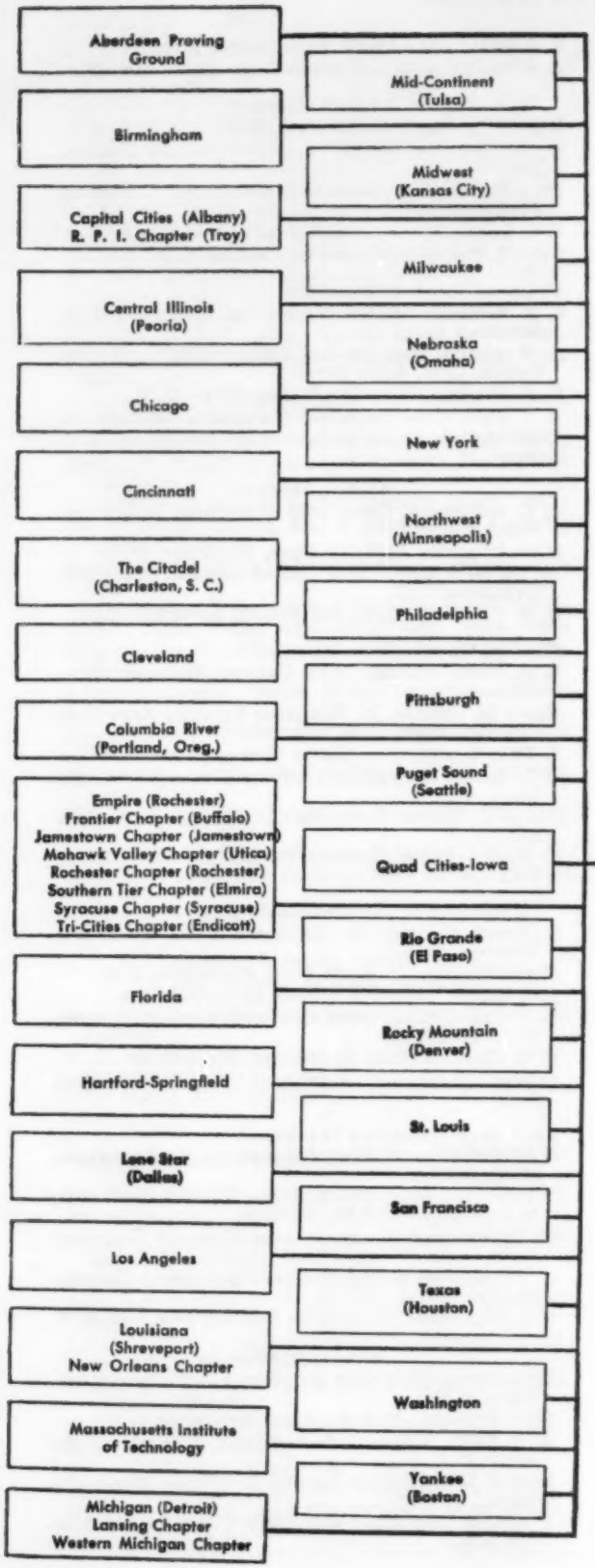

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CASCO PRODUCTS CORPORATION . BRIDGEPORT, CONN.
CASE COMPANY, J. I. . . . . RACINE, WIS.
CATAWISSA VALVE & FITTINGS COMPANY, CATAWISSA, PA.
CATERPILLAR TRACTOR CO. . . . . PEORIA, ILL.
CAVANAU ASSOCIATES, INC., FRANK . DETROIT, MICH.
C. E. M. COMPANY . . . . . DAYVILLE, CONN.
CENTRAL CAN COMPANY . . . . CHICAGO, ILL.
CENTRAL FOUNDRY COMPANY . . NEWARK, N.J.
CENTRAL FOUNDRY DIVISION, GMC . SAGINAW, MICH.
CENTRAL OHIO PAPER COMPANY . . COLUMBUS, OHIO
CENTURY ENGINEERING CORP. . . CEDAR RAPIDS, IOWA
CHAIN BELT COMPANY . . . . MILWAUKEE, WIS.
CHAMBERLAIN CORPORATION . . . WATERLOO, IOWA
CHAMBERSBURG ENGINEERING COMPANY . . . . . CHAMBERSBURG, PA.
CHAMPION SPARK PLUG COMPANY . TOLEDO, OHIO
CHANCE COMPANY, A. B. . . . . CENTRALIA, MO.
CHASE AIRCRAFT COMPANY . . WILLOW RUN, MICH.
CHASE BRASS & COPPER COMPANY WATERBURY, CONN.
CHECKER CAB MANUFACTURING CORPORATION . . . . . KALAMAZOO, MICH.
CHEMICAL CONSTRUCTION CORPORATION . . . . . NEW YORK, N.Y.
CHEVROLET MOTOR DIVISION, GMC . DETROIT, MICH.
CHICAGO EXTRUDED METALS COMPANY . CICERO, ILL.
CHICAGO RAILWAY EQUIPMENT COMPANY, CHICAGO, ILL.
CHICAGO RAWHIDE MANUFACTURING COMPANY . . . . . CHICAGO, ILL.
CHIKSAN COMPANY . . . . . BREA, CALIF.
CHIPMAN KNITTING MILLS . . . . EASTON, PA.
CHRYSLER CORPORATION . . . . DETROIT, MICH.
CHRYSLER MOTOR PARTS CORPORATION . . . . . DETROIT, MICH.
CHRYSLER SALES CORPORATION . . DETROIT, MICH.
CINCINNATI LATHE & TOOL COMPANY CINCINNATI, OHIO
CINCINNATI MILLING MACHINE COMPANY . . . . . CINCINNATI, OHIO
CITIZENS MORTGAGE CORPORATION . DETROIT, MICH.
CLARK EQUIPMENT COMPANY . . BUCHANAN, MICH.
CLARK GRAVE VAULT COMPANY . . COLUMBUS, OHIO
CLARY MULTIPLIER CORPORATION, SAN GABRIEL, CALIF.
CLAYTON MANUFACTURING COMPANY, EL MONTE, CALIF.
CLEARING MACHINE CORPORATION . CHICAGO, ILL.
CLEMATIS MACHINE & FIXTURE COMPANY . . . . . WALTHAM, MASS.
CLEVELAND CONTAINER COMPANY . CLEVELAND, OHIO
CLEVELAND DIESEL ENGINE DIVISION, GMC . . . . . CLEVELAND, OHIO
CLEVELAND GRAPHITE BRONZE COMPANY . . . . . CLEVELAND, OHIO
CLEVELAND PNEUMATIC TOOL COMPANY . . . . . CLEVELAND, OHIO
CLEVELAND TWIST DRILL COMPANY CLEVELAND, OHIO
CLEVELAND WELDING COMPANY . CLEVELAND, OHIO
CLIFFORD MANUFACTURING COMPANY, DIVISION OF STANDARD-THOMSON CORPORATION . . . . . WALTHAM, MASS.
CLIMAX MOLYBDENUM COMPANY . . NEW YORK, N.Y.
CLINE ELECTRIC MANUFACTURING COMPANY . . . . . CHICAGO, ILL.
CLOVER MANUFACTURING COMPANY NORWALK, CONN.
COBUSCO STEEL PRODUCTS . . . DENVER, COLO.
COCA-COLA COMPANY . . . . . ATLANTA, GA.
COLD METAL PRODUCTS COMPANY YOUNGSTOWN, OHIO
COLLINS RADIO COMPANY . . . CEDAR RAPIDS, IOWA
COLONIAL BROACH COMPANY . . . DETROIT, MICH.
COLORADO FUEL & IRON CORPORATION DENVER, COLO.
COLSON CORPORATION . . . . ELYRIA, OHIO
COLT'S MANUFACTURING COMPANY HARTFORD, CONN.
COLUMBIA MILLS, INC. . . . . SYRACUSE, N.Y.
COLUMBUS BOLT & FORGING CO. . . COLUMBUS, OHIO
COMBUSTION ENGINEERING, INC. . . NEW YORK, N.Y.
COMMERCIAL BARGE LINES, INC. . . DETROIT, MICH.
COMMERCIAL CARRIERS, INC. . . . DETROIT, MICH.

Honor Roll of Industrial Preparedness

COMMERCIAL STEEL TREATING CORP. . DETROIT, MICH.
CONE AUTOMATIC MACHINE COMPANY . WINDSOR, VT.
CONMAR PRODUCTS CORPORATION . NEWARK, N.J.
CONSOLIDATED DIESEL ELECTRIC CORPORATION . . . . . STAMFORD, CONN.
CONSOLIDATED NATURAL GAS COMPANY . . . . . NEW YORK, N.Y.
CONSOLIDATED VULTEE AIRCRAFT CORPORATION . . . . . SAN DIEGO, CALIF.
CONSOLIDATED WESTERN STEEL DIVISION, UNITED STATES STEEL CORP. LOS ANGELES, CALIF.
CONTINENTAL AVIATION & ENGINEERING CORPORATION . . . . . DETROIT, MICH.
CONTINENTAL CAN COMPANY . . . NEW YORK, N.Y.
CONTINENTAL FOUNDRY AND MACHINE COMPANY . . . . . EAST CHICAGO, IND.
CONTINENTAL MOTORS CORPORATION DETROIT, MICH.
CONTINENTAL RUBBER WORKS . . . ERIE, PA.
CONTROL INSTRUMENT COMPANY . . NEW YORK, N.Y.
COOK PAINT & VARNISH COMPANY . DETROIT, MICH.
COPPERWELD STEEL COMPANY . . WARREN, OHIO
CORNELL AERONAUTICAL LABORATORY, INC. . . . . BUFFALO, N.Y.
CORNING GLASS WORKS . . . . . CORNING, N.Y.
COUCH COMPANY, S. H. . . NORTH QUINCY, MASS.
CRAFT MANUFACTURING COMPANY . CHICAGO, ILL.
CRANE COMPANY . . . . . CHICAGO, ILL.
CRIBBEN AND SEXTON COMPANY . . CHICAGO, ILL.
CRONAME, INC. . . . . CHICAGO, ILL.
CROSLEY DIVISION, AVCO MANUFACTURING CORPORATION . . . . . CINCINNATI, OHIO
CROSLEY MOTORS, INC. . . . . CINCINNATI, OHIO
CROSS COMPANY . . . . . DETROIT, MICH.
CROWN CAN COMPANY . . . PHILADELPHIA, PA.
CROWN CORK & SEAL COMPANY . . BALTIMORE, MD.
CRUCIBLE STEEL COMPANY OF AMERICA PITTSBURGH, PA.
CURRAN COMPANY, FRANK J. . DOWNERS GROVE, ILL.
CURTISS-WRIGHT CORPORATION . WOOD-RIDGE, N.J.
CUSHMAN MOTOR WORKS . . . . LINCOLN, NEBR.
CUTLER-HAMMER, INC. . . . MILWAUKEE, WIS.

DACO MACHINE AND TOOL COMPANY . NEW YORK, N.Y.
DALTON FOUNDRIES, INC. . . . . WARSAW, IND.
DANLY MACHINE SPECIALTIES, INC. . CHICAGO, ILL.
DANA CORPORATION . . . . . TOLEDO, OHIO
DARBY PRODUCTS OF STEEL PLATE CORPORATION . . . . . KANSAS CITY, KANS.
DARBYSHIRE STEEL COMPANY . . . EL PASO, TEX.
DARLING VALVE & MANUFACTURING COMPANY . . . . . WILLIAMSPORT, PA.
DAVISON CHEMICAL COMPANY, DIVISION OF W. R. GRACE & COMPANY . . . BALTIMORE, MD.
DAY & ZIMMERMAN, INC. . . . PHILADELPHIA, PA.
DAYSTROM ELECTRIC CORPORATION, POUGHKEEPSIE, N.Y.
DAYTON MALLEABLE IRON COMPANY . DAYTON, OHIO
DAYTON RUBBER COMPANY . . . DAYTON, OHIO
DAZEY CORPORATION . . . . . ST. LOUIS, MO.
DEARBORN GAGE COMPANY . . DEARBORN, MICH.
DEERE & COMPANY . . . . . MOLINE, ILL.
DELCO APPLIANCE DIVISION, GMC . ROCHESTER, N.Y.
DELCO PRODUCTS DIVISION, GMC . . DAYTON, OHIO
DELCO-REMY DIVISION, GMC . . . ANDERSON, IND.
DELTA TANK MANUFACTURING COMPANY, INC. . . . . BATON ROUGE, LA.
DENISON ENGINEERING COMPANY . COLUMBUS, OHIO
DEPENDABLE AUTOMATIC SCREW COMPANY . . . . . WATERBURY, CONN.
DE SANNO & SON, INC., A. P. . . PHOENIXVILLE, PA.
DE SOTO MOTOR CORPORATION . . DETROIT, MICH.
DETREX CORPORATION . . . . DETROIT, MICH.
DETROIT ALUMINUM AND BRASS CORP. DETROIT, MICH.
DETROIT BALL BEARING COMPANY OF MICHIGAN . . . . . DETROIT, MICH.
DETROIT BRASS & MALLEABLE COMPANY . . . . . DETROIT, MICH.
DETROIT CONTROLS CORPORATION . DETROIT, MICH.
DETROIT DIESEL ENGINE DIVISION, GMC DETROIT, MICH.
DETROIT EDISON COMPANY . . . DETROIT, MICH.
DETROIT GASKET & MANUFACTURING COMPANY . . . . . DETROIT, MICH.
DETROIT HARVESTER COMPANY . . DETROIT, MICH.
DETROIT-MICHIGAN STOVE COMPANY . DETROIT, MICH.
DETROIT PLATING INDUSTRIES . . DETROIT, MICH.
DETROIT STAMPING COMPANY . . . DETROIT, MICH.
DETROIT STEEL CORPORATION . . DETROIT, MICH.
DETROIT STEEL PRODUCTS COMPANY . DETROIT, MICH.
DETROIT TRANSMISSION DIVISION, GMC . . . . . WILLOW RUN, MICH.
DEVLIEG MACHINE COMPANY . . . FERNDALE, MICH.
DEXTER COMPANY . . . . . FAIRFIELD, IOWA
DIAMOND MATCH COMPANY . . . NEW YORK, N.Y.
DIESEL EQUIPMENT DIVISION, GMC, GRAND RAPIDS, MICH.
DISSTON & SONS, INC., HENRY . PHILADELPHIA, PA.
DIVCO CORPORATION . . . . . DETROIT, MICH.
DIXIE CUP COMPANY . . . . . EASTON, PA.
DOALL COMPANY . . . . . DES PLAINES, ILL.
DOCKENDORFF AND COMPANY, INC., BRIDGEPORT, CONN.
DODGE BROTHERS CORPORATION . . DETROIT, MICH.
DOELCAM CORPORATION . . . . NEWTON, MASS.
DOUGLAS AIRCRAFT COMPANY SANTA MONICA, CALIF.
DOUGLAS & LOMASON COMPANY . . DETROIT, MICH.
DRAPER CORPORATION . . . . HOPEDALE, MASS.
DRAVO CORPORATION . . . . . PITTSBURGH, PA.
DRUGE BROTHERS MANUFACTURING COMPANY . . . . . OAKLAND, CALIF.
DUAL-MOTORS CORPORATION . . . DETROIT, MICH.
DUNCAN ELECTRIC MANUFACTURING COMPANY . . . . . LAFAYETTE, IND.
DUNHAM COMPANY, C. A. . . . . CHICAGO, ILL.
DU PONT DE NEMOURS & COMPANY, E. I. . . . . WILMINGTON, DEL.
DURHAM MANUFACTURING CORPORATION, MUNCIE, IND.
DURIRON COMPANY . . . . . DAYTON, OHIO

E & L TRANSPORT COMPANY . . DEARBORN, MICH.
EAGLE-PICHER COMPANY . . . CINCINNATI, OHIO
EAGLE TOOL & MACHINE COMPANY SPRINGFIELD, OHIO
EAST COAST AERONAUTICS, INC. . . PELHAM, N.Y.
EASTERN STAINLESS STEEL CORP. . BALTIMORE, MD.
EASTERN TOOL & MANUFACTURING COMPANY . . . . . BELLEVILLE, N.J.
EASTMAN KODAK COMPANY . . . ROCHESTER, N.Y.
EASY WASHING MACHINE CORPORATION, SYRACUSE, N.Y.
EATON MANUFACTURING COMPANY . CLEVELAND, OHIO

Honor Roll of Industrial Preparedness

EDGERTON, GERMESHAUSEN & GRIER, INC. BOSTON, MASS.
EDGEWATER STEEL COMPANY . . . PITTSBURGH, PA.
EDNALITE OPTICAL COMPANY . . . PEEKSKILL, N.Y.
EISEN BROTHERS, INC. . . . . HOBOKEN, N.J.
EKCO PRODUCTS COMPANY . . . CHICAGO, ILL.
ELASTIC STOP NUT CORPORATION OF AMERICA . . . . . UNION, N.J.
ELECTRIC AUTO-LITE COMPANY . . . TOLEDO, OHIO
ELECTRIC FURNACE COMPANY . . . SALEM, OHIO
ELECTRIC STORAGE BATTERY COMPANY . . . . . PHILADELPHIA, PA.
ELECTRICAL ENGINEERING AND MANUFACTURING CORPORATION . . . . LOS ANGELES, CALIF.
ELECTRO REFRACTORIES & ABRASIVES CORPORATION . . . . . BUFFALO, N.Y.
ELECTRO TEC CORPORATION SOUTH HACKENSACK, N.J.
ELECTROL, INCORPORATED . . . KINGSTON, N.Y.
ELGIN NATIONAL WATCH COMPANY . . ELGIN, ILL.
ELKHART ENGINEERING & MFG. CO. . . . . ELKHART LAKE, WIS.
ELLIOTT COMPANY . . . . . JEANNETTE, PA.
ELLWOOD CITY FORGE COMPANY . ELLWOOD CITY, PA.
EMERSON ELECTRIC MANUFACTURING COMPANY . . . . . ST. LOUIS, MO.
EMERSON RADIO & PHONOGRAPH CORPORATION . . . . . NEW YORK, N.Y.
EMSCO MANUFACTURING COMPANY, LOS ANGELES, CALIF.
ENGINEERING AND RESEARCH DIVISION, ACF INDUSTRIES, INCORPORATED HYATTSVILLE, MD.
ENGLANDER COMPANY . . . . BIRMINGHAM, ALA.
ENTERPRISE MACHINE PARTS CORPORATION . . . . . DETROIT, MICH.
ENTERPRISE MANUFACTURING COMPANY AKRON, OHIO
ENTERPRISE TOOL & GEAR CORPORATION, DETROIT, MICH.
ERIE RESISTOR CORPORATION . . . . ERIE, PA.
ESPEY MANUFACTURING COMPANY . NEW YORK, N.Y.
ESSEX BRASS CORPORATION . . . DETROIT, MICH.
ESSO STANDARD OIL COMPANY . . NEW YORK, N.Y.
EUREKA WILLIAMS COMPANY, DIVISION OF HENNEY MOTOR COMPANY . . BLOOMINGTON, ILL.
EVANS PRODUCTS COMPANY . . PLYMOUTH, MICH.
EVANS' SONS, INC., JOHN . . . PHILADELPHIA, PA.
EX-CELL-O CORPORATION . . . . DETROIT, MICH.
EXACT WEIGHT SCALE COMPANY . . COLUMBUS, OHIO
EXPERIMENT INCORPORATED . . . RICHMOND, VA.

FABRICON PRODUCTS, INC. . . RIVER ROUGE, MICH.
FACS PRODUCTS, INC. . . . . CHICAGO, ILL.
FAFNIR BEARING COMPANY . NEW BRITAIN, CONN.
FAIRBANKS COMPANY . . . . NEW YORK, N.Y.
FAIRBANKS, MORSE & COMPANY . . CHICAGO, ILL.
FAIRCHILD ENGINE AND AIRPLANE CORPORATION . . . . . FARMINGDALE, N.Y.
FALK CORPORATION . . . . MILWAUKEE, WIS.
FALSTROM COMPANY . . . . . PASSAIC, N.J.
FANSTEEL METALLURGICAL CORP. . NORTH CHICAGO, ILL.
FARBER, INC., S. W. . . . . NEW YORK, N.Y.
FARGO MOTOR CORPORATION . . . DETROIT, MICH.
FARRAND OPTICAL COMPANY . . . NEW YORK, N.Y.
FARREL-BIRMINGHAM COMPANY . . ANSONIA, CONN.
FASCO INDUSTRIES, INC. . . . . ROCHESTER, N.Y.
FAYSCOTT CORPORATION . . . . DEXTER, MAINE
FEDDERS-QUIGAN CORPORATION . . BUFFALO, N.Y.
FEDERAL DROP FORGE COMPANY . . LANSING, MICH.
FEDERAL ELECTRIC PRODUCTS COMPANY . NEWARK, N.J.
FEDERAL LABORATORIES, INC. . SALTSBURG, PA.
FEDERAL-MOGUL CORPORATION . . DETROIT, MICH.
FEDERAL TELECOMMUNICATIONS LABORATORIES, DIVISION OF INTERNATIONAL TELEPHONE AND TELEGRAPH CORP. . . . . NUTLEY, N.J.
FEDERAL TELEPHONE AND RADIO COMPANY . . . . . CLIFTON, N.J.
FELLOWS GEAR SHAPER COMPANY . SPRINGFIELD, VT.
FELT AND TARRANT MANUFACTURING COMPANY . . . . . CHICAGO, ILL.
FENN MANUFACTURING COMPANY NEWINGTON, CONN.
FERRACUTE MACHINE COMPANY . . BRIDGETON, N.J.
FIDELITY-PHILADELPHIA TRUST COMPANY . . . . . PHILADELPHIA, PA.
FIFTH THIRD UNION TRUST COMPANY . . . . . CINCINNATI, OHIO
FILER & STOWELL COMPANY . . MILWAUKEE, WIS.
FIRESTONE TIRE & RUBBER COMPANY . AKRON, OHIO
FIRST FEDERAL SAVINGS & LOAN ASSOCIATION OF DETROIT . . . . . DETROIT, MICH.
FIRTH STERLING INC. . . . . PITTSBURGH, PA.
FISHER BODY DIVISION, GMC . . . DETROIT, MICH.
FITZGIBBONS BOILER COMPANY . . NEW YORK, N.Y.
FITZSIMONS MANUFACTURING COMPANY, DETROIT, MICH.
FLANNERY MANUFACTURING COMPANY, BRIDGEVILLE, PA.
FLOUR CITY ORNAMENTAL IRON COMPANY . . . . . MINNEAPOLIS, MINN.
FLUOR CORPORATION . . . . LOS ANGELES, CALIF.
FLYNN MANUFACTURING COMPANY, MICHAEL . . . . . PHILADELPHIA, PA.
FOOD MACHINERY AND CHEMICAL CORPORATION . . . . . SAN JOSE, CALIF.
FORD INSTRUMENT COMPANY, DIVISION OF SPERRY CORPORATION . . LONG ISLAND CITY, N.Y.
FORD MOTOR COMPANY . . . . . CHESTER, PA.
FORD MOTOR COMPANY . . . DEARBORN, MICH.
FOSTER WHEELER CORPORATION . . NEW YORK, N.Y.
FOUR WHEEL DRIVE AUTO COMPANY, CLINTONVILLE, WIS.
FRAM CORPORATION . . . . PROVIDENCE, R.I.
FRANTZ COMPANY, S. G. . . . . TRENTON, N.J.
FREBANK COMPANY . . . . GLENDALE, CALIF.
FRICK-GALLAGHER MFG. COMPANY . WELLSTON, OHIO
FRIGIDAIRE DIVISION, GMC . . . DAYTON, OHIO
FRUEHAUF TRAILER COMPANY . . DETROIT, MICH.
FULLER BRUSH COMPANY . . . HARTFORD, CONN.
FULLER MANUFACTURING COMPANY, KALAMAZOO, MICH.
GAGE PRODUCTS COMPANY . . FERNDALE, MICH.
GAIR COMPANY, ROBERT . . . . NEW YORK, N.Y.
GAR WOOD INDUSTRIES, INC. . . . WAYNE, MICH.
GARLAND MANUFACTURING COMPANY DETROIT, MICH.
GARRETT COMPANY, GEORGE K. . PHILADELPHIA, PA.
GATES RUBBER COMPANY . . . . DENVER, COLO.
GAZDA ENGINEERING . . . . PROVIDENCE, R.I.
GEAR GRINDING MACHINE COMPANY . DETROIT, MICH.
GEHRINGER & FORSYTH . . . . DETROIT, MICH.
GENERAL AMERICAN TRANSPORTATION CORPORATION . . . . . CHICAGO, ILL.
GENERAL ANILINE & FILM CORPORATION . . . . . NEW YORK, N.Y.

Honor Roll of Industrial Preparedness

GENERAL DYNAMICS CORPORATION . NEW YORK, N.Y.
GENERAL ELECTRIC COMPANY . . SCHENECTADY, N.Y.
GENERAL FIREPROOFING COMPANY, YOUNGSTOWN, OHIO
GENERAL MALLEABLE CORPORATION WAUKESHA, WIS.
GENERAL METALFAB COMPANY . . . DALLAS, TEX.
GENERAL METALS CORPORATION, SAN FRANCISCO, CALIF.
GENERAL MOTORS CORPORATION . . DETROIT, MICH.
GENERAL MOTORS TRUCK & COACH DIV., GMC . . . . . PONTIAC, MICH.
GENERAL PRECISION EQUIPMENT CORPORATION . . . . . NEW YORK, N.Y.
GENERAL RAILWAY SIGNAL COMPANY ROCHESTER, N.Y.
GENERAL STEEL CASTINGS CORP. . GRANITE CITY, ILL.
GENERAL STEEL PRODUCTS CORPORATION, FLUSHING, N.Y.
GENERAL TEXTILE MILLS, INC. . . NEW YORK, N.Y.
GENERAL TIME CORPORATION . . . NEW YORK, N.Y.
GENERAL TIRE & RUBBER COMPANY . . AKRON, OHIO
GENISCO, INCORPORATED . . . LOS ANGELES, CALIF.
GERITY-MICHIGAN CORPORATION . . ADRIAN, MICH.
GEROTOR MAY CORPORATION . . . BALTIMORE, MD.
GERSTENSLAGER COMPANY . . . WOOSTER, OHIO
GEUDER, PAESCHKE & FREY COMPANY, MILWAUKEE, WIS.
GIANNINI & COMPANY, G. M. . . PASADENA, CALIF.
GIBBS MANUFACTURING & RESEARCH CORPORATION . . . . . JANESVILLE, WIS.
GIBSON REFRIGERATOR COMPANY . GREENVILLE, MICH.
GIDDINGS & LEWIS MACHINE TOOL COMPANY . . . . . FOND DU LAC, WIS.
GILBERT & BARKER MANUFACTURING COMPANY . . . . WEST SPRINGFIELD, MASS.
GILFILLAN BROTHERS, INC. . . LOS ANGELES, CALIF.
GISHOLT MACHINE COMPANY . . . MADISON, WIS.
GIVEN MACHINERY COMPANY . . LOS ANGELES, CALIF.
GLEASON WORKS . . . . . ROCHESTER, N.Y.
GLIDDEN COMPANY . . . . . CLEVELAND, OHIO
GLOBE AMERICAN CORPORATION . . KOKOMO, IND.
GLOBE LIGHTING PRODUCTS, INC. . . BROOKLYN, N.Y.
G. M. CO MANUFACTURING, INC., LONG ISLAND CITY, N.Y.
GMC TRUCK & COACH DIVISION . . PONTIAC, MICH.
GOODRICH COMPANY, B. F. . . . . AKRON, OHIO
GOODYEAR AIRCRAFT CORPORATION . . AKRON, OHIO
GOODYEAR TIRE & RUBBER COMPANY . AKRON, OHIO
GORHAM MANUFACTURING COMPANY PROVIDENCE, R.I.
GORTON MACHINE COMPANY, GEO. . . RACINE, WIS.
GOSS PRINTING PRESS COMPANY . . CHICAGO, ILL.
GOULD-NATIONAL BATTERIES, INC. . ST. PAUL, MINN.
GRABLER MANUFACTURING CO. . CLEVELAND, OHIO
GRAFLEX, INC. . . . . ROCHESTER, N.Y.
GRAMMES AND SONS, INC., L. F. . . ALLENTOWN, PA.
GRAND RAPIDS BRASS COMPANY GRAND RAPIDS, MICH.
GRANITE CITY STEEL COMPANY . GRANITE CITY, ILL.
GREAT LAKES SPRING DIV., STANDARD STEEL SPRING CO. . . . . CHICAGO, ILL.
GREAT LAKES STEEL CORPORATION . DETROIT, MICH.
GREENFIELD TAP AND DIE CORPORATION . . . . . GREENFIELD, MASS.
GREER HYDRAULICS, INC. . . . . BROOKLYN, N.Y.
GRIFFIN ENGINEERING COMPANY . WORTHINGTON, IND.
GROVES & SONS COMPANY, S. J. . MINNEAPOLIS, MINN.
GRUEN WATCH COMPANY . . . CINCINNATI, OHIO
GUARANTEE SPECIALTY MANUFACTURING COMPANY . . . . . CLEVELAND, OHIO
GUIDE LAMP DIVISION, GMC . . . ANDERSON, IND.
GULF OIL CORPORATION . . . . PITTSBURGH, PA.
GURLEY, W. & L. E. . . . . TROY, N.Y.

H & H MANUFACTURING COMPANY, CLIFTON HEIGHTS, PA.
HAGAN CORPORATION . . . . . PITTSBURGH, PA.
HALOID COMPANY . . . . . ROCHESTER, N.Y.
HAMILTON FOUNDRY & MACHINE COMPANY . . . . . HAMILTON, OHIO
HAMILTON WATCH COMPANY . . . LANCASTER, PA.
HANCOCK MANUFACTURING COMPANY JACKSON, MICH.
HANDY & HARMAN . . . . . NEW YORK, N.Y.
HANNIFIN CORPORATION . . . DES PLAINES, ILL.
HANSON-VAN WINKLE-MUNNING COMPANY . . . . . MATAWAN, N.J.
HARDY MANUFACTURING CORPORATION . . . . . PENDLETON, IND.
HARNISCHFEGER CORPORATION . MILWAUKEE, WIS.
HARRINGTON & RICHARDSON, INC. WORCESTER, MASS.
HARRIS FOUNDRY & MACHINE COMPANY CORDELE, GA.
HARRIS-SEYBOLD COMPANY . . CLEVELAND, OHIO
HARRISBURG STEEL CORPORATION HARRISBURG, PA.
HARSHAW CHEMICAL COMPANY . CLEVELAND, OHIO
HART & COOLEY MANUFACTURING COMPANY . . . . . HOLLAND, MICH.
HART METAL PRODUCTS CORPORATION ELKHART, IND.
HARVEY MACHINE COMPANY . . TORRANCE, CALIF.
HAYS MANUFACTURING COMPANY . . . ERIE, PA.
HECKETHORN MANUFACTURING & SUPPLY COMPANY . . . . . LITTLETON, COLO.
HEIL COMPANY . . . . . MILWAUKEE, WIS.
HEINEMANN ELECTRIC COMPANY . . TRENTON, N.J.
HEINTZ MANUFACTURING COMPANY, PHILADELPHIA, PA.
HENDRICK MANUFACTURING COMPANY . . . . . CARBONDALE, PA.
HENRY & WRIGHT DIV., EMHART MANUFACTURING COMPANY . . . . . HARTFORD, CONN.
HEPPENSTALL COMPANY . . . . PITTSBURGH, PA.
HERCULES MOTORS CORPORATION . CANTON, OHIO
HERCULES POWDER COMPANY . WILMINGTON, DEL.
HESSE-EASTERN CORPORATION . CAMBRIDGE, MASS.
HEYDEN CHEMICAL CORPORATION . NEW YORK, N.Y.
HEYL & PATTERSON, INC. . . . . PITTSBURGH, PA.
HEYWOOD WAKEFIELD COMPANY . . GARDNER, MASS.
HICKS & SON COMPANY, S. D. . . . BOSTON, MASS.
HIGGINS, INC. . . . . NEW ORLEANS, LA.
HIGH SPEED HAMMER COMPANY . . ROCHESTER, N.Y.
HIGH STANDARD MANUFACTURING CORPORATION . . . . . HAMDEN, CONN.
HILLER HELICOPTERS . . . . PALO ALTO, CALIF.
HI-Q DIVISION, AEROVOX CORPORATION OLEAN, N.Y.
HOBART BROTHERS COMPANY . . . . TROY, OHIO
HOBART MANUFACTURING COMPANY . . TROY, OHIO
HOE & CO., INC., R. . . . . NEW YORK, N.Y.
HOEGANAES SPONGE IRON CORPORATION . . . . . NEW YORK, N.Y.
HOFFMAN LABORATORIES, INC. . LOS ANGELES, CALIF.
HOFMANN & COMPANY, ALFRED WEST NEW YORK, N.J.
HOHWIELER RUBBER COMPANY . MORRISVILLE, PA.
HOLDEN COMPANY, A. F. . . . . DETROIT, MICH.
HOLLAND HITCH COMPANY . . . HOLLAND, MICH.
HOLLINGSHEAD CORPORATION, R. M. . . CAMDEN, N.J.

Honor Roll of Industrial Preparedness

HOLLOW BORING CORPORATION . WORCESTER, MASS.
HOLO-KROME SCREW CORPORATION . ELMWOOD, CONN.
HOMAN & COMPANY . . . . CINCINNATI, OHIO
HOOSIER TARPAULIN & CANVAS GOODS COMPANY . . . . . INDIANAPOLIS, IND.
HOOVER COMPANY . . . . NORTH CANTON, OHIO
HORROCKS-IBBOTSON COMPANY . . . UTICA, N.Y.
HOTPOINT CO. . . . . CHICAGO, ILL.
HOUDAILLE-HERSHEY CORPORATION . DETROIT, MICH.
HOUGH COMPANY, FRANK G. . . LIBERTYVILLE, ILL.
HOUGHTON & COMPANY, E. F. . PHILADELPHIA, PA.
HUBENY BROTHERS, INC. . . . . ROSELLE, N.J.
HUDSON MOTOR CAR COMPANY . . DETROIT, MICH.
HUDSON SHARP MACHINE COMPANY . GREEN BAY, WIS.
HUGHES AIRCRAFT COMPANY . . CULVER CITY, CALIF.
HUGHES TOOL COMPANY . . . . HOUSTON, TEX.
HUNTER DOUGLAS CORPORATION . RIVERSIDE, CALIF.
HUNTER SPRING COMPANY . . . LANSDALE, PA.
HUPP CORPORATION . . . . CLEVELAND, OHIO
HURD LOCK & MANUFACTURING COMPANY . . . . . DETROIT, MICH.
HUSSEY & COMPANY, C. G., DIVISION OF COPPER RANGE COMPANY . . . PITTSBURGH, PA.
HUSSMANN REFRIGERATOR COMPANY ST. LOUIS, MO.
HYATT BEARINGS DIVISION, GMC . . HARRISON, N.J.
HYCON MANUFACTURING COMPANY PASADENA, CALIF.
HYDRAULIC PRESS MANUFACTURING COMPANY . . . . . MOUNT GILEAD, OHIO
HYDROPRESS, INC. . . . . NEW YORK, N.Y.

IDEAL INDUSTRIES, INC. . . . . SYCAMORE, ILL.
ILLINOIS GEAR & MACHINE COMPANY CHICAGO, ILL.
INDEPENDENT LOCK COMPANY . FITCHBURG, MASS.
INDIANA GEAR WORKS, INC. . . INDIANAPOLIS, IND.
INDUSTRIAL FILTER & PUMP MANUFACTURING COMPANY . . . . . CHICAGO, ILL.
INDUSTRIAL TOOL & MACHINE COMPANY . . . . . GEORGIAVILLE, R.I.
INDUSTRIAL WIRE CLOTH PRODUCTS CORPORATION . . . . . WAYNE, MICH.
INGALLS IRON WORKS COMPANY BIRMINGHAM, ALA.
INGRAHAM COMPANY, E. . . . . BRISTOL, CONN.
INLAND MANUFACTURING DIV., GMC . DAYTON, OHIO
INLAND STEEL COMPANY . . . . CHICAGO, ILL.
INLAND STEEL PRODUCTS COMPANY MILWAUKEE, WIS.
INMAN MANUFACTURING COMPANY . AMSTERDAM, N.Y.
INTER-COASTAL PAINT CORP. . . EAST ST. LOUIS, ILL.
INTERNATIONAL BUSINESS MACHINES CORPORATION . . . . . NEW YORK, N.Y.
INTERNATIONAL HARVESTER COMPANY CHICAGO, ILL.
INTERNATIONAL NICKEL COMPANY, HUNTINGTON, W.VA.
INTERNATIONAL PROJECTOR CORPORATION . . . . . BLOOMFIELD, N.J.
INTERNATIONAL SILVER COMPANY . MERIDEN, CONN.
IONIA MANUFACTURING COMPANY . . IONIA, MICH.
ITHACA GUN COMPANY . . . . . ITHACA, N.Y.

JACKES-EVANS MANUFACTURING COMPANY . . . . . ST. LOUIS, MO.
JACKSON AND CHURCH COMPANY . . SAGINAW, MICH.
JACOBS COMPANY, F. L. . . . . DETROIT, MICH.
JANNEY CYLINDER COMPANY . . PHILADELPHIA, PA.
JARVIS ENGINEERING WORKS . . . LANSING, MICH.
JERNBERG FORGINGS COMPANY . . CHICAGO, ILL.
JESSOP STEEL COMPANY . . . WASHINGTON, PA.
JOHNS-MANVILLE SALES CORPORATION, NEW YORK, N.Y.
JOHNSON GAGE COMPANY . . . BLOOMFIELD, CONN.
JOHNSON SERVICE COMPANY . . MILWAUKEE, WIS.
JOHNSTON, INC., HERRICK L. . . COLUMBUS, OHIO
JONES & LAMSON MACHINE COMPANY, SPRINGFIELD, VT.
JONES & LAUGHLIN STEEL CORPORATION . . . . . PITTSBURGH, PA.
JOY MANUFACTURING COMPANY . . PITTSBURGH, PA.

KABLE PRINTING COMPANY . . MOUNT MORRIS, ILL.
KAHN ASSOCIATED ARCHITECTS & ENGINEERS, INC., ALBERT . . . . . DETROIT, MICH.
KAISER COMPANY, HENRY J. . . . OAKLAND, CALIF.
KAISER METAL PRODUCTS, INC. . . . BRISTOL, PA.
KAISER STEEL CORPORATION . . . OAKLAND, CALIF.
KAYDON ENGINEERING CORPORATION . . . . . MUSKEGON, MICH.
KEARFOTT COMPANY . . . . LITTLE FALLS, N.J.
KEARNEY & TRECKER CORPORATION WEST ALLIS, WIS.
KEEBLE ASSOCIATES, INC., EDWIN A., NASHVILLE, TENN.
KELLY-SPRINGFIELD TIRE COMPANY CUMBERLAND, MD.
KELSEY-HAYES WHEEL COMPANY . . DETROIT, MICH.
KENNAMETAL, INC. . . . . LATROBE, PA.
KENNEDY-VAN SAUN MANUFACTURING & ENGINEERING COMPANY . . . DANVILLE, PA.
KENT-MOORE ORGANIZATION, INC. . DETROIT, MICH.
KENWORTH MOTOR TRUCK CORP. . . SEATTLE, WASH.
KEUFFEL & ESSER COMPANY . . . HOBOKEN, N.J.
KEYSTONE MANUFACTURING COMPANY . . . . . BOSTON, MASS.
KIDDE & COMPANY, WALTER . . . BELLEVILLE, N.J.
KILGORE, INC. . . . . WESTERVILLE, OHIO
KING POWDER COMPANY . . . CINCINNATI, OHIO
KING-SEELEY CORPORATION . . ANN ARBOR, MICH.
KNAPP-MONARCH COMPANY . . . ST. LOUIS, MO.
KNOX METAL PRODUCTS, INC. . . THOMSON, GA.
KOEHRING COMPANY . . . . MILWAUKEE, WIS.
KOHLER COMPANY . . . . . KOHLER, WIS.
KOLLSMAN INSTRUMENT CORPORATION ELMHURST, N.Y.
KOPPERS COMPANY . . . . . PITTSBURGH, PA.
KOVEN & BROTHER, INC., L. O. . JERSEY CITY, N.J.
KWIKSET LOCKS, INC. . . . . ANAHEIM, CALIF.
KYSOR HEATER COMPANY . . . . CADILLAC, MICH.

LACLEDE STEEL COMPANY . . . . ST. LOUIS, MO.
LAMSON CORPORATION . . . . SYRACUSE, N.Y.
LANDERS FRARY & CLARK . NEW BRITAIN, CONN.
LANSDOWNE STEEL & IRON COMPANY. MORTON, PA.
LANSING DROP FORGE COMPANY . . LANSING, MICH.
LAPOINTE MACHINE TOOL COMPANY . HUDSON, MASS.
LEAR, INCORPORATED . . . GRAND RAPIDS, MICH.
LEBANON STEEL FOUNDRY . . . LEBANON, PA.
LE BUS ROTARY TOOL WORKS, INC. . LONGVIEW, TEX.
LEE TIRE & RUBBER COMPANY OF NEW YORK, INC. . . . CONSHOHOCKEN, PA.
LEECE-NEVILLE COMPANY . . . CLEVELAND, OHIO
LEEDS & NORTHRUP COMPANY . PHILADELPHIA, PA.
LEHIGH FOUNDRIES, INC. . . . . EASTON, PA.
LEMPCO PRODUCTS, INC. . . . . BEDFORD, OHIO

Honor Roll of Industrial Preparedness

LENNOX FURNACE COMPANY . . COLUMBUS, OHIO
LETOURNEAU, INC., R. G. . . . . LONGVIEW, TEX.
LIBBEY-OWENS-FORD GLASS COMPANY TOLEDO, OHIO
LIEBERKNECHT, INC., KARL . . . . READING, PA.
LIGGETT SUPPLY & EQUIPMENT COMPANY, INC. . . . . ELKHART, IND.
LIGON BROTHERS . . . . . DETROIT, MICH.
LINCOLN ELECTRIC COMPANY . . CLEVELAND, OHIO
LINCOLN ENGINEERING COMPANY . ST. LOUIS, MO.
LINK AVIATION, INC. . . . . BINGHAMTON, N.Y.
LINK-BELT COMPANY . . . . . CHICAGO, ILL.
LION MANUFACTURING CORPORATION . CHICAGO, ILL.
LIPE-ROLLWAY CORPORATION . . . SYRACUSE, N.Y.
LITTLE, INC., ARTHUR D. . . . . CAMBRIDGE, MASS.
LOCKHEED AIRCRAFT CORPORATION . BURBANK, CALIF.
LOFSTRAND COMPANY . . . . . ROCKVILLE, MD.
LOFTUS ENGINEERING CORPORATION . PITTSBURGH, PA.
LONE STAR STEEL COMPANY . . . DALLAS, TEX.
LONGREN AIRCRAFT COMPANY . TORRANCE, CALIF.
LORRILLARD COMPANY, P. . . . . NEW YORK, N.Y.
L-R HEAT TREATING COMPANY . . NEWARK, N.J.
LUKENS STEEL COMPANY . . . COATESVILLE, PA.
LUMMUS COMPANY . . . . . NEW YORK, N.Y.
LUX CLOCK MANUFACTURING CO. WATERBURY, CONN.
LYCOMING-SPENCER DIVISION, AVCO MANUFACTURING CORPORATION WILLIAMSPORT, PA.
LYNCHBURG FOUNDRY COMPANY . . LYNCHBURG, VA.
LYON, INCORPORATED . . . . . DETROIT, MICH.

MACK MANUFACTURING CORPORATION NEW YORK, N.Y.
MACK MOLDING COMPANY, INC. . . . WAYNE, N.J.
MACKINTOSH-HEMPHILL COMPANY . PITTSBURGH, PA.
MADISON-KIPP CORPORATION . . . MADISON, WIS.
MAGNAFLUX CORPORATION . . . CHICAGO, ILL.
MAGNAVOX COMPANY . . . . FORT WAYNE, IND.
MAGNETIC METALS COMPANY . . . . CAMDEN, N.J.
MAHON COMPANY, R. C. . . . . DETROIT, MICH.
MALL TOOL COMPANY . . . . . CHICAGO, ILL.
MANSFIELD TIRE & RUBBER COMPANY, MANSFIELD, OHIO
MANUFACTURERS ENGINEERING CORPORATION . . . . . DETROIT, MICH.
MANUFACTURERS NATIONAL BANK OF DETROIT . . . . . DETROIT, MICH.
MARKEM MACHINE COMPANY . . . KEENE, N.H.
MARLBORO WIRE GOODS COMPANY MARLBORO, MASS.
MARLIN FIREARMS COMPANY . . NEW HAVEN, CONN.
MARLIN-ROCKWELL CORPORATION JAMESTOWN, N.Y.
MARMON-HERRINGTON COMPANY . INDIANAPOLIS, IND.
MARSHALL STEEL COMPANY . . . LA GRANGE, ILL.
MARTIN COMPANY, GLENN L. . . . BALTIMORE, MD.
MARTIN IRON WORKS . . . . . RENO, NEV.
MARTIN-PARRY CORPORATION . WASHINGTON, D.C.
MASCO SCREW PRODUCTS COMPANY DEARBORN, MICH.
MASON & HANGER COMPANY . . . NEW YORK, N.Y.
MASON COMPANY, L. E. . . . HYDE PARK, MASS.
MASSEY-HARRIS-FERGUSON, INC. . . RACINE, WIS.
MASSMAN CONSTRUCTION CO. . . KANSAS CITY, MO.
MASTER BUILDERS COMPANY . . CLEVELAND, OHIO
MATHEWS CONVEYOR COMPANY . ELLWOOD CITY, PA.
MATHEWSON TOOL COMPANY . . WEST HAVEN, CONN.
MATTATUCK MANUFACTURING COMPANY . . . . . WATERBURY, CONN.
MAXSON CORPORATION, W. L. . . NEW YORK, N.Y.
MAYTAG COMPANY . . . . . NEWTON, IOWA
MCCONWAY & TORLEY CORPORATION PITTSBURGH, PA.
MCCORD CORPORATION . . . . DETROIT, MICH.
MCGLYNN HAYS INDUSTRIES, INC. . BELLEVILLE, N.J.
MCGRAW ELECTRIC COMPANY . . . CHICAGO, ILL.
MCINERNEY SPRING & WIRE CO. GRAND RAPIDS, MICH.
MCKAY COMPANY . . . . . PITTSBURGH, PA.
MCKIERNAN-TERRY CORPORATION . HARRISON, N.J.
MCLOUTH STEEL CORPORATION . . DETROIT, MICH.
MCQUAY-NORRIS MANUFACTURING COMPANY . . . . . ST. LOUIS, MO.
MECHANICAL HANDLING SYSTEMS, INC. DETROIT, MICH.
MEDART COMPANY . . . . . ST. LOUIS, MO.
MELCHOIR, ARMSTRONG, DESSAU COMPANY OF DELAWARE, INC. . . . . RIDGEFIELD, N.J.
MELLING FORGING COMPANY . . . LANSING, MICH.
MERGENTHALER LINOTYPE COMPANY . NEW YORK, N.Y.
MERZ ENGINEERING, INC. . . . . INDIANAPOLIS, IND.
MESTA MACHINE COMPANY . . . PITTSBURGH, PA.
METAL AUTO PARTS COMPANY . INDIANAPOLIS, IND.
METAL SPECIALTY COMPANY . . CINCINNATI, OHIO
METALS DISINTEGRATING COMPANY . ELIZABETH, N.J.
METROPOLITAN BODY COMPANY . BRIDGEPORT, CONN.
MEYER MANUFACTURING COMPANY, GEO. J. . . . . CUDAHY, WIS.
MICA INSULATOR COMPANY . . SCHENECTADY, N.Y.
MICHIGAN CONSOLIDATED GAS COMPANY, DETROIT, MICH.
MICHIGAN STEEL TUBE PRODUCTS COMPANY . . . . . DETROIT, MICH.
MICROMATIC HONE CORPORATION . DETROIT, MICH.
MIDVALE COMPANY . . . . . PHILADELPHIA, PA.
MIDWAY COMPANY . . . . . NEWARK, N.J.
MID-WEST ABRASIVE COMPANY . . OWOSSO, MICH.
MIDWEST PIPING COMPANY . . . ST. LOUIS, MO.
MILCO UNDERGARMENT COMPANY . BLOOMSBURG, PA.
MILLER MANUFACTURING COMPANY . DETROIT, MICH.
MILLER PRINTING MACHINERY COMPANY . . . . . PITTSBURGH, PA.
MILLS INDUSTRIES, INCORPORATED . CHICAGO, ILL.
MINIATURE PRECISION BEARINGS, INC. . KEENE, N.H.
MINNEAPOLIS-HONEYWELL REGULATOR COMPANY . . . . . MINNEAPOLIS, MINN.
MINNEAPOLIS-MOLINE COMPANY . MINNEAPOLIS, MINN.
MISSION APPLIANCE CORPORATION WHITTIER, CALIF.
MISSISSIPPI RIVER FUEL CORPORATION ST. LOUIS, MO.
MISSISSIPPI VALLEY BARGE LINE COMPANY . . . . . ST. LOUIS, MO.
MITCHELL COMPANY, JOHN E. . . . DALLAS, TEX.
MODINE MANUFACTURING COMPANY . . RACINE, WIS.
MONARCH ALUMINUM MFG. COMPANY, CLEVELAND, OHIO
MONARCH GOVERNOR COMPANY . . DETROIT, MICH.
MONARCH MARKING SYSTEM COMPANY DAYTON, OHIO
MONARCH RUBBER COMPANY . . . HARTVILLE, OHIO
MONROE AUTO EQUIPMENT COMPANY MONROE, MICH.
MONROE CALCULATING MACHINE COMPANY, ORANGE, N.J.
MONTPELIER MANUFACTURING CO. MONTPELIER, OHIO
MOORE DROP FORGING COMPANY . SPRINGFIELD, MASS.
MOORE ENAMELING & MANUFACTURING COMPANY . . . . . W. LAFAYETTE, OHIO
MOORLANE COMPANY . . . . . TULSA, OKLA.
MORAINE PRODUCTS DIVISION, GMC . DAYTON, OHIO

Honor Roll of Industrial Preparedness

MOREY MACHINERY COMPANY . . ASTORIA, N.Y.
MORGAN CONSTRUCTION COMPANY WORCESTER, MASS.
MORGAN ENGINEERING COMPANY . . ALLIANCE, OHIO
MORRISON STEEL PRODUCTS, INC. . BUFFALO, N.Y.
MORSE-SMITH-MORSE COMPANY . WATERTOWN, MASS.
MOSLER LOCK COMPANY . . . . COVINGTON, KY.
MOSLER SAFE COMPANY . . . . HAMILTON, OHIO
MOTOR PRODUCTS CORPORATION . . DETROIT, MICH.
MOTOR WHEEL CORPORATION . . . LANSING, MICH.
MOTOROLA, INC. . . . . CHICAGO, ILL.
MOTTER'S SONS, GEO. P. . . . . YORK, PA.
MUELLER COMPANY . . . . . DECATUR, ILL.
MUELLER BRASS COMPANY . . PORT HURON, MICH.
MULLINS MANUFACTURING CORPORATION SALEM, OHIO
MUNCIE GEAR WORKS, INC. . . . MUNCIE, IND.
MURRAY MANUFACTURING CORP. . NEW YORK, N.Y.
MURRAY OHIO MANUFACTURING COMPANY . . . . . CLEVELAND, OHIO
MYSTIK ADHESIVE PRODUCTS . . . CHICAGO, ILL.

NAGEL-CHASE MANUFACTURING COMPANY, CHICAGO, ILL.
NARROW FABRIC COMPANY . . . . READING, PA.
NASH ENGINEERING COMPANY . . . . SOUTH NORWALK, CONN.
NASH-KELVINATOR CORPORATION . DETROIT, MICH.
NATIONAL ACME COMPANY . . CLEVELAND, OHIO
NATIONAL AUTOMOTIVE FIBERS, INC. DETROIT, MICH.
NATIONAL BANK OF DETROIT . . . DETROIT, MICH.
NATIONAL BROACH & MACHINE COMPANY . . . . . DETROIT, MICH.
NATIONAL CAN CORPORATION . . CHICAGO, ILL.
NATIONAL CASH REGISTER COMPANY . DAYTON, OHIO
NATIONAL FIREWORKS ORDNANCE CORPORATION . . . . WEST HANOVER, MASS.
NATIONAL GYPSUM COMPANY . . . BUFFALO, N.Y.
NATIONAL MACHINE PRODUCTS CO. . UTICA, MICH.
NATIONAL MACHINERY COMPANY . . . TIFFIN, OHIO
NATIONAL MALLEABLE & STEEL CASTINGS COMPANY . . . . . CLEVELAND, OHIO
NATIONAL PNEUMATIC COMPANY . . BOSTON, MASS.
NATIONAL POWDER COMPANY . . . ELDRED, PA.
NATIONAL PRESTO INDUSTRIES . . EAU CLAIRE, WIS.
NATIONAL RADIATOR COMPANY . JOHNSTOWN, PA.
NATIONAL REJECTORS, INC. . . . ST. LOUIS, MO.
NATIONAL RESEARCH CORPORATION CAMBRIDGE, MASS.
NATIONAL ROLL & FOUNDRY COMPANY AVONMORE, PA.
NATIONAL SCREW & MANUFACTURING COMPANY . . . . . CLEVELAND, OHIO
NATIONAL SUPPLY COMPANY . . . PITTSBURGH, PA.
NATIONAL TOOL SALVAGE COMPANY . DETROIT, MICH.
NATIONAL TUBE DIVISION, UNITED STATES STEEL CORPORATION . . . . PITTSBURGH, PA.
NATIONAL VENDORS, INC. . . . . ST. LOUIS, MO.
NEAPCO PRODUCTS, INC. . . . . POTTSTOWN, PA.
NESCO, INC. . . . . MILWAUKEE, WIS.
NEVILLE CHEMICAL COMPANY . . PITTSBURGH, PA.
NEW BRITAIN MACHINE COMPANY NEW BRITAIN, CONN.
NEW DEPARTURE DIVISION, GMC . . BRISTOL, CONN.
NEW HAMPSHIRE BALL BEARINGS, INC. . . . . PETERBOROUGH, N.H.
NEW HAVEN CLOCK AND WATCH COMPANY . . . . . NEW HAVEN, CONN.
NEW PROCESS GEAR CORPORATION . SYRACUSE, N.Y.
NEW YORK AIR BRAKE COMPANY . . NEW YORK, N.Y.
NEWARK STOVE COMPANY . . . NEWARK, OHIO
NEWTON-NEW HAVEN COMPANY . WEST HAVEN, CONN.
NIAGARA BLOWER COMPANY . . . NEW YORK, N.Y.
NORDBERG MANUFACTURING CO. . MILWAUKEE, WIS.
NORMA-HOFFMANN BEARINGS CORP. STAMFORD, CONN.
NORQUIST PRODUCTS, INC. . . JAMESTOWN, N.Y.
NORRIS, MANUFACTURER, INC., W. C. . TULSA, OKLA.
NORRIS-THERMADOR CORPORATION, LOS ANGELES, CALIF.
NORTH AMERICAN AVIATION . LOS ANGELES, CALIF.
NORTHERN ORDNANCE INCORPORATED MINNEAPOLIS, MINN.
NORTHFIELD FOUNDRY & MACHINE COMPANY . . . . . NORTHFIELD, MINN.
NORTHROP AIRCRAFT, INC., ANAHEIM DIVISION . . . . . ANAHEIM, CALIF.
NORTHWEST AUTOMATIC PRODUCTS CORPORATION . . . . MINNEAPOLIS, MINN.
NORTON COMPANY . . . . . WORCESTER, MASS.

OAKITE PRODUCTS, INC. . . . . NEW YORK, N.Y.
OHIO RUBBER COMPANY . . . WILLOUGHBY, OHIO
OHIO STEEL FOUNDRY COMPANY . . . LIMA, OHIO
OILGEAR COMPANY . . . . MILWAUKEE, WIS.
OILJAK MANUFACTURING COMPANY MONTCLAIR, N.J.
O'KEEFE & MERRITT COMPANY LOS ANGELES, CALIF.
OLDSMOBILE DIVISION, GMC . . . LANSING, MICH.
OLIN MATHIESON CHEMICAL CORPORATION . . . . . BALTIMORE, MD.
OLIN MATHIESON CHEMICAL CORPORATION . . . . . NEW YORK, N.Y.
OLIVER CORPORATION . . . . . CHICAGO, ILL.
OLOFSSON CORPORATION . . . . LANSING, MICH.
OLSEN MANUFACTURING COMPANY, SAMUEL . . . . . CHICAGO, ILL.
ONEIDA LTD. . . . . ONEIDA, N.Y.
ONONDAGA POTTERY COMPANY . . SYRACUSE, N.Y.
ONSRUD MACHINE WORKS, INC. . . CHICAGO, ILL.
OPTICAL GAGING PRODUCTS, INC. . . ROCHESTER, N.Y.
OTIS ELEVATOR COMPANY . . . . NEW YORK, N.Y.
OWENS-CORNING FIBERGLAS CORPORATION . . . . . WASHINGTON, D.C.

PACE CORPORATION . . . . BASE LINE, MICH.
PACIFIC CAR AND FOUNDRY COMPANY RENTON, WASH.
PACKARD ELECTRIC DIVISION, GMC . WARREN, OHIO
PACKARD MOTOR CAR COMPANY . . DETROIT, MICH.
PANTEX MANUFACTURING CORP. . PAWTUCKET, R.I.
PARISH PRESSED STEEL COMPANY . READING, PA.
PARKE THOMPSON ASSOCIATES . . KIRKWOOD, MO.
PARKER APPLIANCE COMPANY . CLEVELAND, OHIO
PARKER PEN COMPANY. . . . . JANESVILLE, WIS.
PARKER RUST PROOF COMPANY . . DETROIT, MICH.
PASS & SEYMOUR, INC.. . . . . SYRACUSE, N.Y.
PECO PLANT, JOHN BEAN DIVISION, FOOD MACHINERY AND CHEMICAL CORPORATION . . . . . PHILADELPHIA, PA.
PEERLESS OF AMERICA, INC. . . . CHICAGO, ILL.
PEMCO CORPORATION . . . . . BALTIMORE, MD.
PENNSYLVANIA OPTICAL COMPANY . . READING, PA.
PENNSYLVANIA PAPYRUS CORP. . PHILADELPHIA, PA.

Honor Roll of Industrial Preparedness

PENNSYLVANIA SALT MANUFACTURING COMPANY . . . . . PHILADELPHIA, PA.
PERFECTION STEEL BODY COMPANY . GALION, OHIO
PERPEX CORPORATION . . . MILWAUKEE, WIS.
PHELPS DODGE COPPER PRODUCTS CORPORATION . . . . . NEW YORK, N.Y.
PHILADELPHIA BRONZE & BRASS CORPORATION . . . . . PHILADELPHIA, PA.
PHILCO CORPORATION . . . . PHILADELPHIA, PA.
PHOENIX BRIDGE COMPANY . . PHOENIXVILLE, PA.
PIASECKI HELICOPTER CORPORATION . MORTON, PA.
PICKANDS MATHER & COMPANY . CLEVELAND, OHIO
PIERCE GOVERNOR COMPANY, INC. . ANDERSON, IND.
PITNEY-BOWES, INC. . . . . STAMFORD, CONN.
PITTSBURGH CONSOLIDATION COAL COMPANY . . . . . PITTSBURGH, PA.
PITTSBURGH FORGINGS COMPANY . . CORAOPOLIS, PA.
PITTSBURGH PLATE GLASS COMPANY . PITTSBURGH, PA.
PITTSBURGH STEEL FOUNDRY CORPORATION . . . . . PITTSBURGH, PA.
PITTSBURGH TUBE COMPANY . . . PITTSBURGH, PA.
PLUME & ATWOOD MANUFACTURING COMPANY . . . . . WATERBURY, CONN.
PLYMOUTH MOTOR CORPORATION . DETROIT, MICH.
POLORON PRODUCTS, INC. . . NEW ROCHELLE, N.Y.
PONTIAC MOTOR DIVISION, GMC . . PONTIAC, MICH.
PORCELAIN METALS CORPORATION . LOUISVILLE, KY.
PORTER COMPANY, H. K. . . . . PITTSBURGH, PA.
PORTLAND FORGE & FOUNDRY COMPANY . . . . . PORTLAND, IND.
PRATT & WHITNEY DIVISION, NILES-BEMENT-POND COMPANY . WEST HARTFORD, CONN.
PRECISION CASTINGS COMPANY . . SYRACUSE, N.Y.
PROCTER & GAMBLE COMPANY . CINCINNATI, OHIO
PROCTOR ELECTRIC COMPANY . . PHILADELPHIA, PA.
PULLMAN-STANDARD CAR MANUFACTURING COMPANY . . . . . CHICAGO, ILL.
PYLE-NATIONAL COMPANY . . . CHICAGO, ILL.

RAILWAY SPECIALTIES CORPORATION . BRISTOL, PA.
RANDALL COMPANY . . . . CINCINNATI, OHIO
RAY OIL BURNER COMPANY . SAN FRANCISCO, CALIF.
RAYTHEON MANUFACTURING COMPANY . . . . . WALTHAM, MASS.
RCA VICTOR DIVISION, RADIO CORPORATION OF AMERICA . . . . . CAMDEN, N.J.
REACTION MOTORS, INC. . . . . ROCKAWAY, N.J.
READING BATTERIES, INC. . . . . READING, PA.
READING COMPANY . . . . PHILADELPHIA, PA.
RED ARROW ELECTRONICS CORPORATION . . . . . BELLEVILLE, N.J.
RED LION CABINET COMPANY, REDCO TOOL DIVISION . . . . . RED LION, PA.
REEVES INSTRUMENT CORPORATION . NEW YORK, N.Y.
REGAL WARE, INC. . . . . KEWASKUM, WIS.
REGINA CORPORATION . . . . . RAHWAY, N.J.
REMINGTON ARMS COMPANY . . BRIDGEPORT, CONN.
REMINGTON RAND INC. . . . STAMFORD, CONN.
REO MOTORS, INC. . . . . LANSING, MICH.
REPUBLIC STEEL CORPORATION . CLEVELAND, OHIO
REVERE COPPER & BRASS, INC. . . NEW YORK, N.Y.
REVERE CORPORATION OF AMERICA, INC. . . . . WALLINGFORD, CONN.
REYNOLDS METALS COMPANY . . . RICHMOND, VA.
RHEEM MANUFACTURING COMPANY . NEW YORK, N.Y.
RICHARDS-WILCOX MANUFACTURING COMPANY . . . . . AURORA, ILL.
RICHFIELD OIL CORPORATION . . LOS ANGELES, CALIF.
RICHMOND ENGINEERING COMPNY A. RICHMOND, VA.
RICHMOND SCREW ANCHOR COMPANY . . . . . NEW YORK, N.Y.
RIVERSIDE FOUNDRY, INC. . . BETTENDORF, IOWA
RIVERSIDE METAL COMPANY . . . RIVERSIDE, N.J.
ROBBINS TIRE & RUBBER COMPANY . TUSCUMBIA, ALA.
ROBERTSHAW-FULTON CONTROLS COMPANY . . . . . GREENSBURG, PA.
ROBERTSON COMPANY, H. H. . . . PITTSBURGH, PA.
ROBINSON CLAY PRODUCTS COMPANY . . . . . AKRON, OHIO
ROCHESTER PRODUCTS DIVISION, GMC, ROCHESTER, N.Y.
ROCKWELL MANUFACTURING COMPANY . . . . . PITTSBURGH, PA.
ROCKWOOD SPRINKLER COMPANY WORCESTER, MASS.
ROHM & HAAS COMPANY . . . PHILADELPHIA, PA.
RONSON ART METAL WORKS, INC. . NEWARK, N.J.
ROPER CORPORATION, GEORGE D. . . ROCKFORD, ILL.
ROSS GEAR AND TOOL COMPANY . LAFAYETTE, IND.
ROSS-MEEHAN FOUNDRIES . CHATTANOOGA, TENN.
ROTARY ELECTRIC STEEL COMPANY . DETROIT, MICH.
ROY, INC., ROSS . . . . . DETROIT, MICH.
ROYAL TYPRWRITER COMPANY . HARTFORD, CONN.
ROYLYN INCORPORATED . . . GLENDALE, CALIF.
RUDEL MACHINERY COMPANY . . . NEW YORK, N.Y.
RUDISILL FOUNDRY COMPANY . . ANNISTON, ALA.
RULON COMPANY . . . . . CHICAGO, ILL.
RYCO ENGINEERING, INC. . . . . DETROIT, MICH.
RYERSON & HAYNES, INC. . . . . JACKSON, MICH.

S & S CORRUGATED PAPER MACHINERY COMPANY . . . . . BROOKLYN, N.Y.
SACO-LOWELL SHOPS . . . . . BOSTON, MASS.
SAE STEELS . . . . . CLEVELAND, OHIO
SAGINAW MALLEABLE IRON DIVISION, GMC . . . . . SAGINAW, MICH.
SAGINAW STEERING GEAR DIVISION, GMC . . . . . SAGINAW, MICH.
SAINTE CLAIRE TOOL COMPANY . . DETROIT, MICH.
ST. LOUIS CAR COMPANY . . . . ST. LOUIS, MO.
ST. REGIS PAPER COMPANY . . . NEW YORK, N.Y.
SALEM-BROSIUS, INC. . . . . SALEM, OHIO
SALEM TOOL COMPANY . . . . . SALEM, OHIO
SAMPSEL TIME CONTROL, INC. . SPRING VALLEY, ILL.
SANDERSON & PORTER . . . . NEW YORK, N.Y.
SANDIA CORPORATION . . . ALBUQUERQUE, N.MEX.
SANDPAPER, INC. . . . . ROCKLAND, MASS.
SANDY HILL IRON & BRASS WORKS . . . . . HUDSON FALLS, N.Y.
SARGENT & GREENLEAF, INC. . . . ROCHESTER, N.Y.
SAVAGE ARMS CORPORATION . . . . UTICA, N.Y.
SAWHILL TUBULAR PRODUCTS, INC. . . SHARON, PA.
SCAIFE COMPANY . . . . . PITTSBURGH, PA.
SCHAIBLE COMPANY . . . . CINCINNATI, OHIO
SCHLAGE LOCK COMPANY . . SAN FRANCISCO, CALIF.

Honor Roll of Industrial Preparedness

SCHLITZ BREWING COMPANY, JOSEPH, MILWAUKEE, WIS.
SCHLUETER MANUFACTURING COMPANY, ST. LOUIS, MO.
SCHWEIN ENGINEERING COMPANY . . VAN NUYS, CALIF.
SCHWITZER-CUMMINS COMPANY . INDIANAPOLIS, IND.
SCOVILL MANUFACTURING COMPANY, WATERBURY, CONN.
SCRIPTO, INC. . . . . ATLANTA, GA.
SCULLIN STEEL COMPANY . . . . ST. LOUIS, MO.
SEAMAN MOTORS, INC. . . . . MILWAUKEE, WIS.
SEARS, ROEBUCK AND COMPANY . . CHICAGO, ILL.
SEEGER REFRIGERATOR COMPANY . ST. PAUL, MINN.
SEIBERLING RUBBER COMPANY . . . AKRON, OHIO
SERVEL, INC . . . . . EVANSVILLE, IND.
SESSIONS CLOCK COMPANY . . FORESTVILLE, CONN.
SEXTON CAN COMPANY . . . . EVERETT, MASS.
SHAFER BEARING CORPORATION DOWNERS GROVE, ILL.
SHAKEPROOF, INC., DIV., ILLINOIS TOOL WORKS . . . . . ELGIN, ILL.
SHARON STEEL CORPORATION . . . . SHARON, PA.
SHEAFFER PEN COMPANY, W. A. FORT MADISON, IOWA
SHEFFIELD CORPORATION . . . . DAYTON, OHIO
SHEFFIELD STEEL DIVISION, ARMCO STEEL CORPORATION . . . KANSAS CITY, MO.
SHELL OIL COMPANY . . . . . NEW YORK, N.Y.
SHERWIN-WILLIAMS COMPANY . CLEVELAND, OHIO
SILAS MASON COMPANY . . . SHREVEPORT, LA.
SIMMONS COMPANY . . . . . NEW YORK, N.Y.
SIMMONS MACHINE TOOL CORPORATION ALBANY, N.Y.
SIMONDS SAW & STEEL COMPANY . FITCHBURG, MASS.
SINGER MANUFACTURING COMPANY, ELIZABETHPORT, N.J.
SKF INDUSTRIES, INC. . . . . PHILADELPHIA, PA.
SLACK, INC., A. J. . . . . WORCESTER, MASS.
SLAYMAKER LOCK COMPANY . . . LANCASTER, PA.
SMITH & CORONA TYPEWRITERS, INC., L. C. . . . . SYRACUSE, N.Y.
SMITH & WESSON, INC. . . . SPRINGFIELD, MASS.
SMITH COMPANY, S. MORGAN . . . . YORK, PA.
SMITH COMPANY, T. L. . . . MILWAUKEE, WIS.
SMITH CORPORATION, A. O. . . MILWAUKEE, WIS.
SMITH, DRUM & COMPANY . . PHILADELPHIA, PA.
SNYDER MANUFACTURING COMPANY, H. P. . . . . LITTLE FALLS, N.Y.
SNYDER TOOL & ENGINEERING COMPANY, DETROIT, MICH.
SOCONY-VACUUM OIL COMPANY . . DETROIT, MICH.
SOLAR STEEL CORPORATION . . CLEVELAND, OHIO
SORENG PRODUCTS CORPORATION SCHILLER PARK, ILL.
SOUTH BEND LATHE WORKS . . SOUTH BEND, IND.
SOUTHEASTERN METALS COMPANY . . . . NORTH BIRMINGHAM, ALA.
SOUTHERN COACH MANUFACTURING COMPANY . . . . . EVERGREEN, ALA.
SOUTHERN NATURAL GAS COMPANY BIRMINGHAM, ALA.
SOUTHERN STATES EQUIPMENT CORPORATION . . . . . HAMPTON, GA.
SOUTHWEST STONE COMPANY . . . . DALLAS, TEX.
S-P MANUFACTURING CORPORATION CLEVELAND, OHIO
SPALDING & BROS., INC., A. G. . . CHICOPEE, MASS.
SPARKLER MANUFACTURING COMPANY . . . . . MUNDELEIN, ILL.
SPECIALTIES, INC. . . . . SYOSSET, N.Y.
SPEED-O-PRINT CORPORATION . . CHICAGO, ILL.
SPENCER CHEMICAL COMPANY . KANSAS CITY, MO.
SPERRY CORPORATION . . . . . NEW YORK, N.Y.
SPERRY GYROSCOPE COMPANY . GREAT NECK, N.Y.
SPRAGUE & CARLETON, INC. . . . . KEENE, N.H.
SPRAGUE ELECTRIC COMPANY . NORTH ADAMS, MASS.
SQUARE D COMPANY . . . . . DETROIT, MICH.
STANDARD BOILER & PLATE IRON COMPANY . . . . . PITTSBURGH, PA.
STANDARD COIL PRODUCTS COMPANY . . . . . MELROSE PARK, ILL.
STANDARD CONTAINER, INC. . . . MONTCLAIR, N.J.
STANDARD FORGINGS CORPORATION . CHICAGO, ILL.
STANDARD GAGE COMPANY . . POUGHKEEPSIE, N.Y.
STANDARD OIL COMPANY OF OHIO . . CLEVELAND, OHIO
STANDARD OIL DEVELOPMENT COMPANY, NEW YORK, N.Y.
STANDARD PRODUCTS COMPANY . . DETROIT, MICH.
STANDARD RAILWAY EQUIPMENT MANUFACTURING COMPANY . . CHICAGO, ILL.
STANDARD SERVICE TIRE COMPANY, INC. . . . . SEATTLE, WASH.
STANDARD STEEL SPRING DIVISION, ROCKWELL SPRING AND AXLE COMPANY . . CORAPOLIS, PA.
STANDARD TUBE COMPANY . . . DETROIT, MICH.
STA-RITE PRODUCTS, INC. . . . . DELAVAN, WIS.
STARLINE INCORPORATED . . . . HARVARD, ILL.
STEARNS-ROGERS MANUFACTURING COMPANY . . . . . DENVER, COLO.
STEEL CITY ELECTRIC COMPANY . . PITTSBURGH, PA.
STEEL IMPROVEMENT & FORGE CO. CLEVELAND, OHIO
STEEL PRODUCTS ENGINEERING CO. SPRINGFIELD, OHIO
STERLING ENGINEERING COMPANY . NEWARK, N.J.
STEWART-WARNER CORPORATION . CHICAGO, ILL.
STILE-CRAFT MANUFACTURERS, INC. . ST. LOUIS, MO.
STOCKHAM VALVES & FITTINGS . BIRMINGHAM, ALA.
STOKES MACHINE COMPANY, F. J. PHILADELPHIA, PA.
STOLLE CORPORATION . . . . CINCINNATI, OHIO
STONE & WEBSTER ENGINEERING CORPORATION . . . . . NEW YORK, N.Y.
STONER-MUDGE, INC. . . . . PITTSBURGH, PA.
STREETER-AMET COMPANY . . . CHICAGO, ILL.
STRELINGER COMPANY, CHAS. A. . . DETROIT, MICH.
STRONG STEEL FOUNDRY COMPANY . BUFFALO, N.Y.
STUART OIL COMPANY, D. A. . . . CHICAGO, ILL.
STUDEBAKER CORPORATION . . SOUTH BEND, IND.
SUN ELECTRIC CORPORATION . . . CHICAGO, ILL.
SUN OIL COMPANY . . . . . PHILADELPHIA, PA.
SUNDSTRAND MACHINE TOOL COMPANY ROCKFORD, ILL.
SUPER-VENT COMPANY . . . . CHICAGO, ILL.
SUPERIOR COACH CORPORATION . . . LIMA, OHIO
SUPERIOR STEEL CORPORATION . . CARNEGIE, PA.
SUPREME KNITTING MACHINE COMPANY, NEW YORK, N.Y.
SURFACE COMBUSTION CORPORATION TOLEDO, OHIO
SVERDRUP & PARCEL, INC. . . . ST. LOUIS, MO.
SWAN-FINCH OIL CORPORATION . . NEW YORK, N.Y.
SWANK, INC . . . . . ATTLEBORO, MASS.
SWARD COMPANY, H. A. . . . . INWOOD, N.Y.
SYLVANIA ELECTRIC PRODUCTS, INC. . NEW YORK, N.Y.
SYMINGTON-GOULD CORPORATION . . DEPEW, N.Y.

TALON, INC. . . . . MEADVILLE, PA.
TAYLOR & GASKIN, INC. . . . . DETROIT, MICH.
TEMCO, INC. . . . . NASHVILLE, TENN.
TENNANT, SONS & COMPANY OF NEW YORK, C. . . . . NEW YORK, N.Y.

Honor Roll of Industrial Preparedness

TENNESSEE COAL & IRON DIVISION, U. S. STEEL COMPANY . . . . . FAIRFIELD, ALA.
TENNESSEE CORPORATION . . . . NEW YORK, N.Y.
TENNESSEE EASTMAN COMPANY . KINGSPORT, TENN.
TENNEY ENGINEERING, INC. . . . NEWARK, N.J
TERNSTEDT DIVISION, GMC . . . DETROIT, MICH.
TERRELL MACHINE COMPANY . . . CHARLOTTE, N.C.
TEXAS GULF SULPHUR COMPANY . . NEW YORK, N.Y.
TEXAS INSTRUMENTS INCORPORATED . DALLAS, TEX.
TEXTILE MACHINE WORKS . . . READING, PA.
TEXTILEATHER CORPORATION . . TOLEDO, OHIO
THIOKOL CORPORATION . . . . TRENTON, N.J.
THOMAS INDUSTRIES, INC. . FORT ATKINSON, WIS.
THOMAS MACHINE MANUFACTURING COMPANY . . . . . PITTSBURGH, PA.
THOMPSON PRODUCTS, INC. . . CLEVELAND, OHIO
THOR CORPORATION . . . . . CHICAGO, ILL.
TIMKEN-DETROIT AXLE DIVISION, ROCKWELL SPRING AND AXLE COMPANY . . DETROIT, MICH.
TIMKEN ROLLER BEARING COMPANY . CANTON, OHIO
TIMMS SPRING COMPANY . . . . ELYRIA, OHIO
TITAN METAL MANUFACTURING CO. . BELLEFONT, PA.
TITEFLEX, INC. . . . . NEWARK, N.J.
TOKHEIM CORPORATION . . . FORT WAYNE, IND.
TOOL ENGINEERING SERVICE COMPANY, SWEDESBORO, N.J.
TORRINGTON COMPANY . . . TORRINGTON, CONN.
TOWER IRON WORKS . . . . PROVIDENCE, R.I.
TOWLE & SON COMPANY . . . CONSHOHOCKEN, PA.
TOWNSEND COMPANY . . . . NEW BRIGHTON, PA.
TRACTOMOTIVE CORPORATION . . DEERFIELD, ILL.
TRAILMOBILE, INC. . . . . CINCINNATI, OHIO
TRANSUE & WILLIAMS STEEL FORGING CORPORATION . . . . . ALLIANCE, OHIO
TREADWELL CONSTRUCTION COMPANY MIDLAND, PA.
TREDEGAR COMPANY . . . . . RICHMOND, VA.
TRI-CLOVER MACHINE COMPANY . . KENOSHA, WIS.
TRICO PRODUCTS CORPORATION . . BUFFALO, N.Y.
TRIFARI, KRUSSMAN & FISHEL, INC. PROVIDENCE, R.I.
TRIPLEX CORPORATION OF AMERICA . PUEBLO, COLO.
TROJAN POWDER COMPANY . . . ALLENTOWN, PA.
TUBE REDUCING CORPORATION . WALLINGTON, N.J.
TULSA WINCH DIVISION, VICKERS, INC. TULSA, OKLA.
TURNER BRASS WORKS . . . . SYCAMORE, ILL.
TWIN DISC CLUTCH COMPANY . . . RACINE, WIS.
TYSON BEARING CORPORATION . MASSILLON, OHIO

UDYLITE CORPORATION . . . . DETROIT, MICH.
ULTRASONIC CORPORATION . . CAMBRIDGE, MASS.
UNDERWOOD CORPORATION . . . NEW YORK, N.Y.
UNION BAG & PAPER CORPORATION . NEW YORK, N.Y.
UNION CARBIDE AND CARBON CORP. . NEW YORK, N.Y.
UNION METAL MANUFACTURING COMPANY, CANTON, OHIO
UNITED AIRCRAFT CORPORATION, EAST HARTFORD, CONN.
UNITED-CARR FASTENER CORP. . CAMBRIDGE, MASS.
UNITED CHROMIUM, INC. . . . . NEW YORK, N.Y.
UNITED ENGINEERING & FOUNDRY CO., PITTSBURGH, PA.
UNITED METAL BOX COMPANY . . NEW YORK, N.Y.
UNITED MOTORS SERVICE DIVISION, GMC, DETROIT, MICH.
UNITED SHOE MACHINERY CORPORATION, BOSTON, MASS.
UNITED STATES AIR CONDITIONING CORPORATION . . . . MINNEAPOLIS, MINN.
UNITED STATES HOFFMAN MACHINERY CORPORATION . . . . . AUBURN, N.Y.
UNITED STATES HOFFMAN MACHINERY CORPORATION . . . . . NEW YORK, N.Y.
U. S. INDUSTRIES, INC. . . . . CHICAGO, ILL.
U. S. MACHINE CORPORATION . . . LEBANON, IND.
UNITED STATES PIPE AND FOUNDRY COMPANY . . . . . BIRMINGHAM, ALA.
UNITED STATES RUBBER COMPANY . NEW YORK, N.Y.
UNITED STATES SPRING AND BUMPER COMPANY . . . . . LOS ANGELES, CALIF.
UNITED STATES STEEL CORPORATION PITTSBURGH, PA.
UNITED STATES STEEL SUPPLY DIVISION, UNITED STATES STEEL CORPORATION CHICAGO, ILL.
UNITED STATES TIME CORPORATION, WATERBURY, CONN.
UNITED TUBE CORPORATION OF OHIO, CLEVELAND, OHIO
UNIVERSAL MATCH CORPORATION . ST. LOUIS, MO.
UNIVERSAL OIL PRODUCTS COMPANY, DES PLAINES, ILL.
UNIVERSAL PRODUCTS COMPANY . DEARBORN, MICH.
UNIVERSAL WINDING COMPANY . . CRANSTON, R.I.
UTICA CUTLERY COMPANY . . . . UTICA, N.Y.
VANDERCOOK & SONS, INC. . . . CHICAGO, ILL.
VAN DORN IRON WORKS COMPANY CLEVELAND, OHIO
VAN KEUREN COMPANY . . . WATERTOWN, MASS.
VAN NORMAN COMPANY . . . SPRINGFIELD, MASS.
VANTOOL . . . . . PHILADELPHIA, PA.
VARD INC. . . . . PASADENA, CALIF.
VASCOLOY-RAMET CORPORATION . . WAUKEGAN, ILL.
VEEDER-ROOT, INC. . . . . HARTFORD, CONN.
VERSON ALLSTEEL PRESS COMPANY . CHICAGO, ILL.
VICKERS, INC. . . . . DETROIT, MICH.
VICTOR ADDING MACHINE COMPANY . CHICAGO, ILL.
VICTOR MANUFACTURING & GASKET COMPANY . . . . . CHICAGO, ILL.
VICTORY PLASTICS COMPANY . . . HUDSON, MASS.
VIKING TOOL & MACHINE CORPORATION, BELLEVILLE, N.J.
VISKING CORPORATION . . . . CHICAGO, ILL.
VITRO CORPORATION OF AMERICA . NEW YORK, N.Y.
VOLCO BRASS AND COPPER COMPANY, KENILWORTH, N.J.

WADE ELECTRIC PRODUCTS CO. . . STURGIS, MICH.
WAGNER ELECTRIC CORPORATION . ST. LOUIS, MO.
WAGNER MALLEABLE IRON COMPANY DECATUR, ILL.
WALD INDUSTRIES, INC. . . . HUNTINGTON, PA.
WALSH CONSTRUCTION COMPANY . PORTLAND, ME.
WALTERS MANUFACTURING COMPANY OAKMONT, PA.
WALTHAM WATCH COMPANY . . . WALTHAM, MASS.
WALWORTH COMPANY . . . . . NEW YORK, N.Y.
WARD LAFRANCE TRUCK CORPORATION . ELMIRA, N.Y.
WARE BROTHERS DIVISION, CHICAGO ROLLER SKATE COMPANY . . . . . CHICAGO, ILL.
WARNER & SWASEY COMPANY . CLEVELAND, OHIO
WARNER ELECTRIC BRAKE & CLUTCH COMPANY . . . . . BELOIT, WIS.
WARREN BROTHERS ROADS COMPANY, CAMBRIDGE, MASS.
WARREN WEBSTER & COMPANY . . . CAMDEN, N.J.
WATERBURY COMPANIES, INCORPORATED . . . . . WATERBURY, CONN.
WATERBURY FARREL FOUNDRY & MACHINE COMPANY . . . . . WATERBURY, CONN.
WATSON MANUFACTURING COMPANY . JAMESTOWN, N.Y.

Honor Roll of Industrial Preparedness

WAUKESHA MOTOR COMPANY . . . WAUKESHA, WIS.
WEATHERHEAD COMPANY . . . CLEVELAND, OHIO
WEBB COMPANY, JERVIS B. . . . DETROIT, MICH.
WEBER DENTAL MANUFACTURING COMPANY . . . . . CANTON, OHIO
WEIRTON STEEL COMPANY . . . WEIRTON, W.VA.
WELEX JET SERVICES, INC. . . FORT WORTH, TEX.
WELLMAN COMPANY, S. K. . . . BEDFORD, OHIO
WENDEL, INC., RUDOLF . . . . NEW YORK, N.Y.
WERNER COMPANY, R. D. . . . . GREENVILLE, PA.
WEST BEND ALUMINUM COMPANY . WEST BEND, WIS.
WEST TIRE SETTER COMPANY . . . ROCHESTER, N.Y.
WESTERN ARC WELDING, INC. . LOS ANGELES, CALIF.
WESTERN ELECTRIC COMPANY . . NEW YORK, N.Y.
WESTERN GEAR WORKS . . . LYNWOOD, CALIF.
WESTINGHOUSE AIR BRAKE COMPANY, WILMERDING, PA.
WESTINGHOUSE ELECTRIC CORPORATION . . . . . PITTSBURGH, PA.
WHEEL TRUEING TOOL COMPANY . . DETROIT, MICH.
WHEELER CORPORATION, FOSTER . . NEW YORK, N.Y.
WHEELING STEEL CORPORATION . WHEELING, W.VA.
WHEELOCK, LOVEJOY & COMPANY CAMBRIDGE, MASS.
WHELAND COMPANY . . . CHATTANOOGA, TENN.
WHIRLPOOL CORPORATION . . ST. JOSEPH, MICH.
WHITE MOTOR COMPANY . . . CLEVELAND, OHIO
WHITE RODGERS ELECTRIC COMPANY . ST. LOUIS, MO.
WHITEHEAD & KALES COMPANY . RIVER ROUGE, MICH.
WHITEHEAD STAMPING COMPANY . . DETROIT, MICH.
WHITIN MACHINE WORKS . . WHITINSVILLE, MASS.
WHITING & DAVIS COMPANY . . PLAINVILLE, MASS.
WHITNEY CHAIN COMPANY . . HARTFORD, CONN.
WICKES BROTHERS DIVISION, WICKES CORPORATION . . . . . SAGINAW, MICH.
WICO ELECTRIC COMPANY . WEST SPRINGFIELD, MASS.
WIEGAND COMPANY, EDWIN L. . . PITTSBURGH, PA.
WILCOX FORGING CORPORATION . MECHANICSBURG, PA.
WILLOUGHBY CHEVROLET COMPANY . RICHMOND, IND.
WINCHESTER REPEATING ARMS COMPANY . . . . . NEW HAVEN, CONN.
WINTER-WEISS COMPANY . . . . DENVER, COLO.
WISCONSIN MOTOR CORPORATION MILWAUKEE, WIS.
WOLVERINE FABRICATING & MANUFACTURING COMPANY . . . . . INKSTER, MICH.
WOLVERINE TUBE DIVISION, CALUMET & HECLA, INC. . . . DETROIT, MICH.
WOOD COMPANY, JOHN . . CONSHOHOCKEN, PA.
WOOD COMPANY, R. D. . . . PHILADELPHIA, PA.
WOOD-MOSAIC COMPANY . . . . LOUISVILLE, KY.
WORCESTER PRESSED STEEL COMPANY . . . . . WORCESTER, MASS.
WORCESTER TAPER PIN COMPANY WORCESTER, MASS.
WORDEN-ALLEN COMPANY . . MILWAUKEE, WIS.
WRIGHT MACHINE COMPANY . . WORCESTER, MASS.
WYANDOTTE CHEMICALS CORPORATION . . . . . WYANDOTTE, MICH.
WYCKOFF STEEL COMPANY . . . PITTSBURGH, PA.
WYSONG & MILES COMPANY . . GREENSBORO, N.C.

YALE & TOWNE MANUFACTURING COMPANY . . . . . PHILADELPHIA, PA.
YODER COMPANY . . . . . CLEVELAND, OHIO
YORK CORPORATION . . . . . YORK, PA.
YORK-SHIPLEY, INC. . . . . YORK, PA.
YOUNG RADIATOR COMPANY . . . . RACINE, WIS.
YOUNG SPRING & WIRE CORPORATION, L. A. . . . . DETROIT, MICH.
YOUNGSTOWN SHEET & TUBE COMPANY . . . . . YOUNGSTOWN, OHIO

ZELLER CORPORATION . . . . . DEFIANCE, OHIO
ZENITH RADIO CORPORATION . . . CHICAGO, ILL.
ZIM MANUFACTURING COMPANY . . CHICAGO, ILL.

The National Technical Division and Committees

"Working for Peace" is the motivating principle of all activities of the American Ordnance Association. To further industrial preparedness for peace the Association provides permanent National Technical Divisions and Special Committees organized along commodity lines constantly and immediately available to agencies of the Department of Defense.

Civilian in character and membership, these Divisions and Committees are composed of selected members of the Association whose wartime experience and whose leadership of private industry are outstanding.

Through membership in the Technical Divisions and Committees, the Association proposes to keep together skilled, experienced groups in the critical fields of ordnance production for which there is little or no peacetime counterpart. Maintaining the interest of Division and Committee members and keeping them fully informed is a responsibility of the National Headquarters of the Association and the respective Division and Committee chairmen. These objectives are attained by meetings of the Divisions and Committees from time to time by the publication of timely studies and reports in the Association's bimonthly journal, ORDNANCE, and its monthly report, INDUSTRIAL PREPAREDNESS. Special reports are published as required.

The Association's Committees serve a very important function in the maintenance of contact between industry and the personnel of the services engaged in industrial-preparedness activities. They are purely advisory to the armed services on problems incident to the mass production of special ordnance material in time of emergency. The work, plans, recommendations, and reports of these Committees are not concerned with the actual placing of production contracts by the Department of Defense. Furthermore, at no time do the activities of any Committee have any connection whatsoever with any agreements concerning price, trade, marketing, or any of the incidents of current procurement.

Association Publications

In addition to its national, regional, local, and committee meetings throughout the year in all sections of the country, the American Ordnance Association disseminates authentic information of a nonclassified nature which is published to carry forward the Association's aim of diffusing knowledge among American citizens on ordnance and other armament subjects—land, sea, and air.

The principal publications of the Association are:

ORDNANCE—the bimonthly journal of the Association published continuously since 1920—an attractive medium for the dissemination of information to members. In its pages are presented discussions of current developments in the scientific, engineering, and industrial phases of our national security—military, naval, and air.

THE COMMON DEFENSE—a monthly Washington newsletter on our national security and peace. Published exclusively for members of the Association, THE COMMON DEFENSE is prepared by the editorial staff of the Association. Its reports on our national defense and its point of view make it a valued adjunct of Association membership.

INDUSTRIAL PREPAREDNESS—an analysis of armament progress especially as affecting the work of the Technical Divisions and Committees of the Association. Here are recorded the programs and calendar of meetings of the A.O.A. technical groups together with comments on latest organizational changes in the Army, Navy, and Air Force.

SPECIAL REPORTS—timely analyses of problems and progress relating to the technical advancement of ordnance and other armament as well as the broader industrial and economic fields connected with industrial preparedness in the United States.

Membership in the American Ordnance Association is open to all American citizens. All membership privileges are included in the membership dues: individual members $4.00 a year or $10.00 for three years; life members $100.00; company members (including ten key officials of the company) $100.00 a year.